DEVELOPMENT OF RESISTANCE IN INSECT TO INSECTICIDES : AN ANNOTATED BIBLIOGRAPHY

DISSERTATION

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Certificate

This is to certify that Mr. Rais Akbar has completed his dissertation entitled "Development of Resistance in Insect to Insecticide" in partial fulfillment of the requirements for the degree of Master of Library & Information Science. He has conducted his work under my supervision and guidance.

(NISHAT FATIMA)
Lecturer

Dedicated

To Adorable Parents and
My Loving Brothers
Whom I have always felt
Motivating me at every step since
My Childhood

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Rais Akbar

AIMS, SCOPE AND METHODOLOGY

With regular highlighting of the harmful effects of insecticides/pesticides by scientists and the media they have been side lined despite their effective control of pests.

Their indiscriminate use has lead to a number of problems like killing of natural cremics, secondary pest outbreak and development of resistance in insects to insecticides. Among these development of resistance in insects to insecticides has been a major concern among scientist for quite some time.

Researches are now emphasizing on biological control of the insects. This with to large extent reduce the dependence on chemicals and also reduce the waters, soil and food pollution that is caused by them. For this exclusive research is being carried out to use pesticides which are eco-friendly and also not toxic to the beneficial exists, use of parasites, parasitoids, predators, fungi, bacteria etc is also being encouraged to reduce the dangerous of insects developing resistance.

Integrated Pest Management (IPM) is the best answer for all the problems. It is an approach wherein cultural, physical, mechanical and biological methods of pest control are used and use of chemicals is discouraged, until pest doesn't reach a level where its control by chemical is the only answer. IPM is socially feasible, economic and eco-friendly approach which uses the available techniques in as feasible way as possible. This strategy is to be planned well in advance of planting the crop. To uses simple methods like altering the date of sowing which helps

the most susceptible stage of the crop escape the peak population of the pest.

Changing of the crop microclimate by planting inter crops which attract natural enemies of the pests is also one of its techniques.

Thus with IPM strategies the problem of resistance in insects to insecticides is overcome with minimum monetary inputs and reducing chemical hazards to human beings, animals and natural enemies.

METHODOLOGY:

The primary sources were consulted in the following Libraries.

1. Department of Agriculture, Aligarh Muslim University, Aligarh.
2. Department of Zoology, Aligarh Muslim University, Aligarh.
3. Indian Agriculture of Research Institute (IARI), New Delhi.
4. Maulana Azad Library, Aligarh Muslim University, Aligarh.

The procedure followed in preparing the bibliography is followed:

1. The relevant bibliographical details were noted down 5" x 7" cards following the ISI standards.
2. The primary sources were consulted from Department of Agriculture, Aligarh Muslim University, Aligarh.
3. On the completion of the abstract subject heading were assigned subject headings are completing co-existence of the extent possible.

4. The subjects were arranged in an alphabetical sequence various elements.

5. The subjects were arranged in an alphabetical sequence various elements

6. In the end of three separate alphabetical Index were given.

   i. Author Index

   ii. Title Index

   iii. Subject Index providing reference to various entries by their respective member.

7. Alphabetical list of periodicals are given.

SUBJECT HEADING:

Attempt has been made to given co-existence subject headings as much as possible. It will facilitate the reader to find out desired articles from this bibliography.

A humble effort has been made to follow postulates and principles as suggested by Dr. S.R. Ranganathan in the formation of subject heading. These are arranged strictly by the principle of alphabetical sequence.

STANDARD FOLLOWED:

The Indian Standards recommended for bibliographical references (IS:2381-1963) and classified catalogue code (CCC) of Dr. S. R. Ranganathan have been followed.

ARRANGEMENT:

The entries are arranged under subject heading which are arranged alphabetically following letter by letter method. The entry element of the author is a capitals, followed by the author is in capitals, followed by the secondary element in parenthesis using capital and small letters and then the title of the articles. Subtitle, (if any) then name of the periodical being underlined followed by volume number, issue number, the year, and date giving by using inclusive rotation of the pages of the articles.

Entries of periodical articles are arranged as follows

a. Serial Number

b. Name of the Author/Authors

c. A full stop

d. Title of the contribution including subtitle and alternative title if any.

e. A full stop (.)

f. Title of Periodical being underlined

g. A full stop(.)

h. Volume number

i. Coma (,)

j. Issue number

k. Semi Colon (;)

l. Year

m. Comma (,)

n. Month and date

o. Semicolon (;)

p. Inclusive pages of the article

q. A full stop (.)

SPECIMENS ENTRY:

----------, ACARICIDES, PEST, RESISTANCE.

LECLANT (F). Resistance to Insecticide and acaricides. Journal of Applied Entomology. 77,5; 1999; 5-10.

ABSTRACT:

The entry's in the bibliography contains abstracts given the essential information about the articles. Attempts have been made to papers indicative abstract, so that in most of cases users needs are fulfilled with abstract itself.

Index:

The Index part contains the author index, and title index arranged alphabetically. The index to the specific entry or entries in the bibliography. It is hoped that it will be found useful in consultation of the bibliography.

Part-I

Introduction

INTRODUCTION

Insects are a large group of organism which have six legs and their body is divided into three distinct parts i.e. head thorax and abdomen. They undergo metamorphosis to change from one form to another i.e. from.

These form the largest group of organisms with about 7,00,000 members. They are of great importance as they are both beneficial and harmful to mankind. They are producers of products such as honey, silk, wax etc. and at the same time cause damage to crops by feeding on the leaves and completely defoliating them sucking the cell sap thereby reducing the viability of the plant. They are carriers of disease causing organisms like viruses, bacteria, ricketsia, MLO's etc.

These insects when damage the crop are a nuisance and became a major constraint in agricultural production. At times there attack is so immense that 100% yield loss is caused. There have been instances of huge economic losses caused by insects e.g. the fruit borer which caused complete destruction of cottons field in Andhra Pradesh resulting in sucides by farmers.

Nature has its way of keeping a balance on its own. The existent of natural enemies of these pests but their control has not been effective. In ancient times neem leaves, mustard oil etc. were used to ward off insects from and grains.

In 1940's many new synthetic organic insecticides, mostly of the organochlorine group, became widely available throughout the world for crop protection.

The effective control of the insects by the chemicals lead to the indiscriminate use of these chemicals. No sooner had these been called miraculous chemicals by curtail that reports produce in from Sweden and Switzerland mentioning the development of resistance to DDT in houselines in 1946. Ever since then many insects have shown resistance to different insecticides.

Resistance is the ability in a strain of individuals of a specie to overcome the harmful effects which kill the remainder of the specie.

Resistance is of Two Types:

- An insect is resistant to one insecticide only like DDT this is known as simple resistance.
- If an insect shows resistance to one insecticide for instance DDT then it develops resistance to the entire group for e.g. it is shows resistant to all the organochlorines. This kind of resistance is known as cross resistance.

It is usually thought that insects require 10-15 generations to develop resistance. The insects metabolize the insecticide chemical from toxic to non-toxic.

Marathion is converted to Malaxone which is not take.

Development of resistance in insects to insecticides has been a major concern during recent times. The farmers increase the dose of insecticides resulting in further consequences wherein these harmful chemicals enter the food cycle, cause water pollution leading to a number of harmful diseases.

Insecticide resistance is now recognized to be an important constraint in increasing agricultural productivity. The word "RESISTANCE" is used in instances where insecticide dosage that were formerly effective now meet with control failure. It is a dynamic multidimensional phenomenon dependent on biochemical, physiological, genetic and Ecological factors. All these factors vary with the species of insect, its population and geographical location. Resistant strains of pests develop through survivors and reproduction of individual carrying one or more factors that allow survival after exposure to a given insecticide. The insecticide stress sharply increases the frequency of resistant phenotypes within the exposed population. Resistance to insecticide develops mainly because of its intensive use in situation that would otherwise favour rapid pest build-up.

There are three phases in the development of insecticide resistance in a population. Firstly, when the frequency of resistant insect is very low and the insecticide gives a

satisfactory control. Secondly with the continuous use of the same or related insecticide the frequency of resistant individual increases leading to occasion crop failure and thirdly with the continuous pressure of insecticide there is a large increase in the number of resistant individual in the population and the insecticide became ineffective.

Development of Resistance in Insects:

Resistance is an Acquired Phenomena. Mechanism of resistance is classified into 2. Simple Resistance: the insects develop "R" to One insect and not to other e.g. D.D.T. "R" flies are not "R" to other organochlorims. The flies developed high level of "R" to organochlorines very quickly as compared to organophosphates.

Bennet (1946) while working on Drosophilamelanogaster after 3-15 generations obtained that there was 30 folds "R" against D.D.T. cross-resistant insect population exposed to certain insect have the ability, simultaneously to acquire tolerance to others subjects to they have never been exposed i.e. if insect develops "R" to cyclodienes.

Le Patanural and Salama (1986), while working on a strain of *Sitophilus granarium* that was 176 times more tolerant to rHCH than that of "S" strain and the cross "R" was also high for Dieldrin 76, Aldrin-67, Malathin-1.6, Permethrin, 1.2 and D.D.T.-1.

Factors Responsible for Development of Resistance in Insects:

1. Physiological

2. Behavioral

1. Physiological

a. Bio-chemical

1. Detoxification:

The enzymes become non-specific. The "R" strains contain more and potent enzymes. They "R" qualitatively and quantitatively more potent than the S strains. Actual of MFO and Cyto Chrome P-450 is much more in the "R" strain as compared to the S strain. Several hydrases and hydrolases C turn non-specific to detoxity to xenobiolic.

In 1983, villar and others working Hirokowa Strain of Musca domestic c were "R" to Malathion is found that the esterase activity was greater than in the S strains.

D.D.T. dehydrochlorinase e detoxifies D.D.T.→ D.D.E. This enzyme is under the control of chromosome II and a gave c is present to metabolise/hydrolepse organephosphates. It was reported in houseflies that carboxeylesterase activity was higher in "R" strain than in the "S" strain.

Glutathreene S transfersthis enzyme is controlled by a gene on chromosome II since organophees. "R" colin extremes

inhibitors, so it was found that the "R" strain contain acetycolinesterase e is more powerful than that in the "S" strain. Acetylcolinesterase is sensitive in "R" than in the "S" strain. Acetylcolinesterase is sensitive in "R" than in the "S".

ii. Cuticular Penetration:

The insects penetrate the cuticle of "R" strains more slowly than that of "S" strain. This may be due to the reduced rate of absorption. When insect penetrates slowly, it is quickly metabolized or detoxified but if it penetrate quickly than it is metabolized, in this way the insect dies.

iii. Penetrate to Targets Organs:

The insect effects the vital entity of the important organs of insect i.e. the neuropile. The insecticide is passed and deposited in the ganglia and neuropile. When the insect reaches these points then, there is no barrier. It has been reported that nervous tissue is sensitive and permeable to insect in "R" strain than in the "S" strain.

Storage organ/fat bodies, organochlorines "R" highly lipophylic. These get deposited in the fat bodies. The "R" strains the fat bodies are no more in so that they can accumulate the insect as compared to "S". The 0 of *Periplanata americana* contains 3 times more fat bodies than 0→ and can store 5 times more insect than 0→.

Behavioural:

Avoidance of treated area: In mosquitoes and houseflies they discriminate the treated area. In red scale citrus, when *finapled* and HCL they closed their spiracles. Irritability/decrease period of contact. In M. domestic, if it set on a treated area it flow away immediately.

Vigour:

When insects "R" reared under a selected pressure of insect the *mutritn* of "R" strain as well as the body weight. This emparts greater tolerance to insect.

Genetics of Resistance:

"R" is controlled by certain genes and they may be monognic. Monogenic resistance is like simple resistance of D.D.T. "R" houseflies. If this gave is intercepted/removed/translocated then the "R" ability diminished and it becomes "S". The multiple *polygave* "R" several genes "R" responsible for developed of "R" like S granaries is "R" to rHCH and Dietdrin, Adrin etc. "R" is not sex linked of and 0→ carry the genes from one generation to another Fate et al. Studied the genets of cytochrome P-450 in diazinone "R" strain of housefly and found that there is a presence of oxides gene of chromosome. U. Insect "R" can be conferred on individual by nature/major gene. But the major gene "R" responsible for 10 to 100 folds in "R". The

major gene "R" follows the classical *mendacious* laws providing individual e definite genotype difference.

2. Insecticide Resistance in India:

India is in a somewhat better situation compared to many other parts of the world as insecticide resistance has appeared relatively late and subsequently progress with comparatively slow rate. Also, most of the problem is restricted to the pests of public and animal health sector and insecticide resistance is not really a version problem in agriculture sector as yet. As per available records, at least 31 species of insects are known to have developed resistance to insecticides in India, out of which 19 are insect pests of medical and veterinary importance, 7 are insect infesting stored grain commodities and 5 are pests infecting field crops.

2.1. Public and Animal Health Sector:

In India, the large scale field use of insecticide was started in 1948 for the control of mosquitoes under National Malaria Control Programme. High amount of broad spectrum Chlorinate hydrocarbons were used through out the country under this programme till 1960. This led to the first appearance of DDT resistance in 1952 in mosquito vector of *filaria, culex piplins fatigans wied* in Uttar Pradesh and Maharashtra. Since then mosquitoes are known to be resistant to both DDT and HCH from various parts of the country. This

mosquito was also found to be capable of developing resistance to synthetic pyrethroid, deltamethrin at a very fast rate. The resistance to DDT in another mosquito, *Anapheles stephensi fiston*, which is a vector of malaria in Urban areas, was first reported in 1956 from Tamil Nadu. Later in 1978 it was also reported to have developed resistance to HCH. DDT resistance in *an culicifacies giles* which is a major vector of malaria in rural India was first reported from Gujarat in 1959. Since then thus pest has developed widespread resistance against DDT, HCH and malathion. At present *an culicifacies* Giles is reported to have developed resistance to DDT and HCH throughout the country and situation is serious particularly in western parts of the country where it has developed triple resistance to DDT, HCH and malathion. Another malaria vector,. *Annularis van der walp* was reported to have develop resistance to DDT in Uttar Pradesh, Madhya Pradesh and Bihar in 1967 and to DDT and HCH in Orissa in 1990. DDT resistance in another mosquito, *An. Fluviatilis Tomes* is known to occur at least in Maharashtra and Karnataka.

First occurrence of DDT resistance in three mosquito vectors of viral diseases and drug was reported in 1963 in Aedes aegypti (Linn) from Calcutta 1964 in *Al. Vittatus* (Bigot) from Baroda and 1965 in *Al. Albopictus* (Skuse) from

Lucknow. DDT and HCH resistance in all the three vectors is also known from various parts of the country.

The two species of houseflies v.z. *Musca domestica mebulo* wied and *M. domestica vicnia linn* at present are known to be resistant to DDT and HCH throughout the country since 1957 when the resistance was first reported. This is considered to be a chance selection due to the pesticide application targeted to kill mosquitoes. Wide spread occurrence of DDT and HCH resistance has also been reported in other house hold pests viz. ved bug, cimex hemiptrus Fab; body house, *pediculus humanus corporis* Debeer and ratflea, *xenopsylla cheopsis* (Roth). The bed bug, *C, hemipterus fab* is known to have developed triple resistance to DDT, HCH and malathion.

Among the pests of veterinary importance the cattle tick, *Boophilus microplus, canestrinis* reported to have developed high degree of resistance to lindane as HCH was repeatedly used for its control since 1954.

2.2. Agriculture Sector:

2.2.1. Pests of Stored grains:

The large scale use of pesticides against pests of stored grains started only after early 1970s when India gained self sufficiency in food grain production which led to large amount of storage of grains as buffer stock. Many reports confirming

resistance in storage pests started appearing in early seventies and in about 15 years period almost all major pests attacking stored grains were known to have developed resistance to one or the other insecticide. Detailed studies were carried out on the mechanism of resistance, cross-resistance patterns, biology and behaviour of laboratory induced resistant strain of important pests. The resistance in stored gain pests was first reported in 1971 when flour bettle, Tribolium castancum (Herbst) was found resistant against DDT and malathion resistance from different parts of the country.

In Maharashtra, Punjab and Karanataka, this pest showed resistance to phosphine also high level of resistance to malathion was detected in another species, *T. confusum Duval* in Punjab.

First report of rice weevil, *sitophilus oryzae linn*, becoming resistant to malathion appeared from Uttar Pradesh in 1973 and quickly thereafter it developed resistance to lindane and phosphine in various parts of the country. Malathion, lindane and phosphine resistance in the lesser grain borer, *Rhizopertha domimica* (Fab) was reported from Maharashtra, Haryana, Rajasthan and Uttar Pradesh in 1976. Khapra bettle, *Trogoderma granarium* events with a 40 fold resistance to phosphine was reported from Punjab during 1979. Lindane resistance in the population of leather bettle,

Dermestes maculatus Deg originated from India was detected in 1978. The detailed status of pesticide resistance.

Phenomenon of cross-resistance has been studied in a number of insecticide resistant strains of pests of stored commodities. The cross-resistance to carbaryl and OP compounds in DDT resistant strain of *T.castaneum* and DDT and carbaryl in malathion resistant strain of *S. oryzal* has been demonstrated. Selection of DDT resistance in *S. oryzal* resulted to high level of cross resistance to OP compounds and carbamates and to varying degree to lindane, *cyclolcone* group of pesticides and pyrethrins.

Selection for resistance to DDT and malathion affected adversly the rate of oviposition and fecundity in *S. orygae* and the trend was similar in DDT and phosphine resistant strains of *T. castaneum*.

2.2.2. Pests of Field Crops:

Unline to many developed countries India has the advantage of high crop diversity mainly because of the smaller holdings. This minimizes the chances of large scale pesticidal application over contiguous areas permitting thereby refuse to susceptible types which dilute the effects of selection pressure. Secondly, the agricultural revolution in real sense started in India at a comparatively late stage during mid 1960s when traditional crop varieties were replaced by high yielding

varieties over large areas and emphasis was givens to increased use of water, fertilizer and pesticides for better yield. Because of these two reasons, the pesticide resistance in pests infesting field the pesticide resistance in pests infesting field crops appeared late and developed with a slow pace. It is only now that the resistance is raising its head in agricultural sector and if appropriate action is not taken and it is feared to become a serious threat in near future.

Confirmed reports of pesticide resistance in at least five insect species infesting field crops in India are available. This includes DDT and HCH resistance in singhara *bettl*, DDT, HCH endesulfan, malathion and pyrethroid resistance in tobacco caterpillar; DDT, parathion, feritrothion, melathion and pyrethroid resistance in diamond back moth. DDT, *endrin*, parathion and *fenitration* resistance in diamond back moth; DDT, endrin, parathion and *fenitration* resistance in mustard aphid and phyrethroid resistance in American ballworm. Besides biochemical parameters indicate suspected development of pesticide resistance in Jassid, Empoasea Kerri Pruthi and aphid, Aphis craccivara Koch against organophosphate insecticides but this needs confirmation.

A. Singhara Beetle

The first café of pesticide resistance in field pests in India was reported in 1963 when singhara beetle, *Calercucella birmanica* (Jacoby) collected from out skirts of Delhi was

found to be resistant to DDT and gamma HCH. *Imustigatious rereled* that the two insecticides for which resistance was recorded were in use since 1952 for the control of this pest in the area. Further studies showed that the pest was resistant to many other cylodine insecticides viz. Aldrin, dieldrin, isodrin, toxophene and organophate insecticide malathion. The studies were however, discontinued and information one the current status of pesticide resistance in this pest is not known.

B. Tobacco Caterpillar:

In 1965 failure of HCH to control tobacco caterpillar, *spodoptera litura* (Fab) infesting cauliflower was reported in Rajasthan and laboratory testings established that this was due to a 7 fold resistance. The resistance to HCH in this pest was reported from Haryana in 1971 and in 1984 the pest collected from Andhra Pradesh was found to be resistant to a wide range of insecticides viz malathion, *pyrethramol* (14.73), lindane (16 25 fold) and endosulfan (85.91 fold).

Testing of the population of tobacco caterpillar origninally from Kurnoal and Guntur districts of Andhra Pradesh in 1983 revealed that these was a district rise in resistance to DDT, HCH, endosulfan, malathion and methyl paratheion in Gentur population compared to the population from Kurnool. Resistance to synthetic pyrethroid viz. deltamethrin, cypermethrin permethrin, fenvalerate and cyfloxylate has also been reported. These reports show that

insecticide resistance in this polyphagous pest is fairly used spread in the country involving insecticides of almost all groups.

C. Diamond Back Moth:

First report of insecticide resistance in diamond back moth, *Plutella xylostella* (Linn) appeared from Punjab in 1968 when DDT and parathion failed to control this pest around Ludhiana, Similar reports appeared soon from other areas and resistance was extended to HCH, *endrın*, fenitration and malathion. High degree of resistance to pyrethroids viz. cypermethrin, *fersualerate*, deltamethran and organophoste, quinalphos has been reported threafter in this pest from various parts of the country. Since the diamond back moth has relatively low mobility and a high reproduction capacity; upto 25 generation per year, the rate of development of pesticide resistance in this pest is very fast. It is feared that this pest has developed multiple resistance of all groups of insecticide throughout the country but this needs confirmation. Also, information on mechanism of resistance needs to be generated. The appearance of multiple resistance in this pest over a large area warrants immediate steps for development and adoptıon management strategy.

D. Mustard Aphid:

Mustard aphid, *Iipaphis erysimi* (Kalt) is a key constraint in rapeseed and mustard production in India. At times high amount of pesticides is used to control this pest. A comparison of the susceptibility to insecticides in the population of mustard aphid, occurring in Punjab and Delhi indicated that the Punjab population was 12-18 fold tolerant to malathion and parathion.

Both the insecticides were in common use in Punjab for fairly long time. In a study conducted in Punjab in 1986 received that mustard aphid was 24 fold resistant to endosulfan at Ludhiana and 4-6 fold resistant to malathion at other place. The tolerance was also encountered against dimethoate at some locations in Punjab but the population was susceptible to oxydemeton methyl another recommended pesticide at all the locations tested. The spread of resistance in this pest need to be monitored and appropriate steps need to be taken immediately to contain its further spread.

E. American Bollworm:

Appearance of pesticide resistance in polyphagous American bollworm *Helicoverpa* (*Heliothis*) *armigera* (Hubner) is of serious concern. During the first outbreak of *Helicoverpa* which occurred in October-November, 1987 in the cotton belt of Guntur, Prakashan and Krishna districts of

Andhra Pradesh the coventional pest control measures depending mainly on synthetic pyrethroids and other pesticides had failed. Later in the *reason when the* bolloworm populations moued to pulses, there again insecticides failed to give effective control. This control failure in Andhra Pradesh and also the similar situation in Punjab in 1990-91 cotton season was traced to the development of high degree of resistance to synthetic pyrethroids. The pyrethroid resistance which was observed initially in a limited area of Andhra Pradesh on the population occurring on cotton and pigeonpea is getting *calarged* gradually and now pyrethroid resistance report is available upto Coimbatore in Tamil Nadu. The degree of resistance and also its spread is showing an increasing trend. It is interesting that the pest is resistant to all the three pyrethroids currently used in the country i.e. cypermethrin, fenvalerate and deltamethrin. It has been demonstrated that the pyrethroid resistance in this pest is mainly due to higher rate of metabolism in resistant strains to which cuticle permeability may also contribute to some extent. The survivors of the *H.armigera* from pyrethroid treatment when inbred, the resistance jumped from 3.8 fold to 28 fold in two generation. Which is an indicative of the capacity of the species to develop resistance at a very fast rate.

Resistance to pesticides other than pyrethroid, is also known in *Helicoverpa* in India. In *Guiltier* in Andhra Pradesh,

resistance to DDT (8.8 fold) and monocrotophos (7.5 fold) and in Kurmool (Andhra Pradesh), resistance to DDT (4.8 fold), monocrotophos (6.6 fold) and carbaryl (4.83 fold) was observed compared to Srikakulum population. The pest showed increased tolerance to quinalphos and methonyl in 1990-91 in Andhra Pradesh.

It is apparent that the pest has developed a true multiple resistance in India particularly in southern states like Andhra Pradesh, Tamil Nadu and Karnataka and in north in Punjab and Haryana. It is urgently needed to monitor the levels of resistance in different areas and develop base line toxicity data for the pest. As the resistance is likely to be a semidominant nutrition strain which *coiffeur* resistance by means of increased ability to detoxify the insecticide the role of synergists need to be studied critically. A comprehensive insecticide resistance management plan has to be developed and adopted quickly in order to save the situation from further worsening.

3. FUNDAMENTAL WORK ON RESISTANCE:

A knowledge of cross resistance spectrum resistance mechanism and inheritance of resistance is considered fundamental to develop pesticide resistance management strategy for any pest species.

Although insecticide detoxification has long been recognised as the primary mechanism of resistance, there are other mechanisms involved viz. biochemical, physiological, behavioural and genetic duly limited amounted of work has been done to elucidate the mechanism of resistance in insects in India and most of the work is restricted to the pest of human health importance. Among the pests of crops in India the mechanism of resistance has not been worked out except perhaps in the case of *Helicoverpa armigera* where pyrethroid resistance has been demonstrated due to the increased detoxification in resistant populations. In majority of other cases the resistance has been reported because of the failure of chemicals in controlling pests under field conditions.

It is to be mentioned here that such control failures may be due to various reasons other than to resistance like use of spurious pesticide application of improper dosage, inadequate coverage and wrong application timing etc. The information on the mechanism of resistance is therefore need to be generated urgently atleast in the case of major pest species.

Cross resistance is a phenomenon where a single defence mechanism confers resistance against various toxicants but in the case of multiple resistance different defence mechanisms co-exist in the same strain. The information on this phenomenon is essential for formulating effective chemical based strategy for resistance management. Cross resistance

studies have been undertaken in the case of important pests infesting stored commodities, but this information on crop pests is lacking. Similarly, information on the inheritance of pesticide resistance is scanty in our country. Monitoring for pesticide resistance also has received very little attention. It is only now that organised efforts are being made on regular monitoring of the resistance in the case of *H. armigera* under a network project launched by the ICAR during 1993.

The foregoing account of overall situation shows that insecticide resistance has received very little attention from the point of view of investigating fundamental aspects. It is needless to emphasize the need for developing proper strategy for pesticide resistance management. A greater attention is therefore, needed on the subject and research on fundamental aspects as stated above has to be accelerated for better understanding of the nature of the problem and also for the management of resistance problem in the country.

4. Insecticide Resistance Management:

It is to be seen that most of the reports on the occurrence of pesticide resistance in field pests in the country have emerged out of the isolated investigations and hence limited to reporting field failures of recommended control schedules and some times laboratory conservation of resistance. The systematic approach for generating complete information on spread and intensity of resistance in each cases, cross

resistance patterns, mechanism and management of resistance is lacking. Realising the need, Indian council of Agricultural Research in collaboration with Natural Research Institute, UK launched for the first time in multilocational network project on resistance management in *Helicoverpa armigera* (Hub.) in the country during the 1993. The project has been implemented in a number of problem areas with the aim to develop comprehensive strategies for managing resistance in the pest either by minimizing its occurrence at no problem places or mitigating its impact.

Though the project is yet to show its impact, it is considered that similar efforts are probably needed for other problem pests also in order to get wide spread co-operation which is crucial because individual resistance management programmes may not work effectively if tactics are not coordinated within the wide geographical range of the pest.

The main aim of insecticide resistance management (IRM) is to conserve susceptibility. The strategies used for IRM may be either "preventive" which aim to ensure that resistance does not develop or "curative" with the aim to restore the efficacy of compound to which the pest has already become resistant (47). Both the strategies are based on the assumption that the ratio of resistant and susceptible genotypes can be manipulated by regulating frequency and rate of pesticide application or by encouraging the dilution of

gene pool by immigration of susceptible individuals from untreated areas (25). These has been much research over past three decades on both the aspects worldwide but there is no single practical preventive or curative way available which can be recommended for use by the farmers.

PREVENTIVE STRATEGY

It is a known fact that the continuous widespread use of insecticides inevitably leads to selection of resistant population and once the resistance has set in, it is irreversible in an ecologically closed population (51). The resistance is therefore one way street on which progress, down is positively corrected with the intensity of the selection pressure applied. The development of resistance can possibly be avoided at least delayed using management by moderation which aims to reduce selection Pressure by suggesting use of selectivce insecticides with relatively short persistance, use of novel chemicals (51, 52); applying chemicals only when warranted i.e. when population is above economic threshold leave (26) and use of other cost effective non-chemical methods of pest control. There is an urgent need, therefore for a shift from over dependence on chemicals based pest control technology to integrated Pest Management (IPM) as this is based on harassing all factors against a pest management by multiple attack in which insecticides are used in alternation, mixtures or definite spatial and temporal patterns referred to as mosaics

also has a special relevance as delaying tactics for the development of insecticide resistance (15, 21). It is to be understood very clearly that the development of resistance is an over present risk in agriculture and we have to be vigilant to ensure that its development is avoided or at least delayed by very careful execution of preventive PRM practices. Since Research efforts are needed for developing soft-control operations based on right chemicals in right doses at right time using most appropriate application methods and suitably rotated with other control tactics.

CURATIVE MEASURES

When a pest develops resistance to one group of insecticides the usual counter measurement is to change to insecticides of other groups with different mode of action. It is, however, worthwhile to mention here that there is no type of pesticides soft for which the resistance has not been reported from one place or the other. The resistance cases has been reported from one place or the other. The resistance cases has been reported for such a diverse and new pesticides as chitin inhibitors. Juvenile harmones and *Bacillus thurkngiensis* (51.) The products are therefore, to be used widely in IPM programmes and combined with a range of pest control measures i.e. chemical, biological and cultural practices or methods to ensure that no one product or method is used so frequently as to promote insecticide resistance.

Also, it is to be kept in mind that the resistance problem is increasing at a fate and the introduction of new chemicals is showing down due to the high cost involved for developing a new *molecute*. As a consequence many research organisations are directing their efforts to improve the effectiveness of existing products. The available pesticides therefore, to be used carefully and judiciously as to minimize the resistance problem and also to safeguard the biotic component of the environment. All the pest control looks must be utilized in a balanced manner in order to break the selection cycles for any one of them. Only through this approach the utility of insecticides can be pressured for a longer period. The chemical when therefore, has to be utilized wisely.

Only possible solution to resistance was the discovery of synergists that would restore the effectiveness of insecticides to which resistance has developed by exhibiting detoxification mechanism. This method is predicted on the concept that the action of a synergist is to inhibit a detoxifying enzyme within the body of the insects thus preventing insecticide degradation. As a result, the insecticide concentration remains high and kills the otherwise resistant insects. The addition of DMC to DDT proved sysnergistic and made the mixture effective against DDT resistant houseflies and detoxification inhibitor with OP compound piperny butoxide, which exhibited both microgomal oxedation and esterase enzymes

was founding promising (10). The insects were however, abole to quickly develop resistance to these insecticide synergist mixtures. A synergist will not be effective if the resistance mechanism is not metlabolic or if the chosen synergist fails to inhibit the pertinent enzyme. The synergists are therefore, promising in mitigating certain specific problems to a limited extend.

The theory of management by saturation which aims at overcoming resistance by using strong of insecticides that kill resistant insects is not advisable in most cases due to risks of environmental contamination. Use of avocados wherever possible, has been suggested against resistant populations because the eggs have either no or very poorly developed detoxification. It is, therefore, seen that the number of option available for IRM is limited and also there are practical constraints in implementing them. The only way to contain resistance problem is perhaps the adoption of an Ecological approach to pest control i.e. IPM. This is the soundest and safest approach and needs encouragement before the situation is really out of hands.

CRITICAL RESEARCH GAPS:

In most cases in India, the resistance has been reported as the failure of an insecticide to control field population as it used to do earlier. The first thing that needs to be done is to demonstrate that there is a true resistance problem and central

failure is not due to some other reasons like poor spraying techniques, improper timing and wrong during doing and use of expired or spurious chemicals do. This is a simple exercise provided there are established base lines for susceptible populations but this can not be done satisfactorily once the resistance has set in due to difficulty in locating the susceptible strains. It is therefore, desirable to develop base line susceptibility data for all key pests against major insecticides.

Although pesticides resistance has been reported in a number of cases in India, the mechanism of resistance has not been studied except in the case of *Helicoverpa armigera* and perhaps *Anopheles stepnensi*.

In most other cases it has been *preseemed* that the resistance is due to increased detoxification of the pesticide. The detoxiffication inhibitors like *pyrethri* synergist pipernyle butoxide. Which inhibits both microsomal oxidation and estarase enzymes in general have great potential in insecticide resistance management. The use of such synergists is possible only when the correct information on detoxification mechanism of each insecticide is available.

It is important to determine whether resistant strain has developed cross resistance or multiple resistance through bio-chemical and physiological studies. Cross-resistance denotes a resistance in a strain to chemicals other than the selective

insecticide, due to same mechanism while multiple resistance is the tolerance of the same strain to several unrelated insecticides but resulting from different mechanisms. This information is needed for planning of sequential use pattern for available chemical groups. Though the facilities to do this work exist at many places in the country, the information generated so far is negligible.

FUTURE THRUSTS

There is a need for putting concerted efforts in investigating resistance problem systematically. The first thing that needs to be done is to demonstrate that the suspected occurrence of resistance reported due to the control failure under field conditions is a three resistance problem. This is possible by comparing the sensitivity of the sample population to the control. After this, it is desirable to proceed with mapping the level of resistance among the colonies collected from different location. The spread of resistance then need to be monitored regularly.

The information on mechanism of resistance and cross-resistance patterns has to be generated on priority atleast for major problem cases. In absence of this information it is not possible to plan suitable sequential use pattern for available group of pesticides.

Research efforts need to be accelerated for developing practical eco-friendly biorational approaches for pest management like cultural practices, use of resistant varieties natural pest control agents like parasites, predators, bio-pesticides and soft natural pesticides like neem.

This will help in formulating practical Integrated Pest management Strategy for large area application which is the only ultimate answer for preventive Insecticide Resistance Management.

Part-II

Annotated Bibliography

INSECTICIDES, RESISTANCE ACARICIDES, PEST,

1. **LECLANT (F):** Resistance of insecticides and acaricides Journal of Applied Entomology, 77, 5; 1999; 5-10

This articles deals with the resistance to insecticides and the insecticide and acaricides resistance in pest populations is reviewed. Aspects covered include present situation and areteadents, methods for evaluating resistance, origin and genetics of resistance, physiological and biochemical mechanisms of resistance and modes of action of insecticides (penetration, metabolic detoxification, trap protein, changes in sensitive sites and epidemicology of resistance (conditions for appearance of resistance, possibilities for limiting development of resistance).

----------, ADULT CULEX PIPLINES, RESISTANCE MEASUREMENT.

2. **GUNEIDY (A), EDEID (A) and SALEM (H).** Measurement of the level of resistance to insecticides in adult culex piplines. Annual Review of Entomology. 50,1; 1990; p. 82-99.

The article deals with the resistance to insecticides in adult culex piplines. A laboratory strain of c. piplines originating from Manshour province, Egypt was tested for the development of resistance to dichloruos, Folimate, carbaryl, dimetilan, Isolan, DDT, dieldrin, aldrin and endrin. Tests were conducted

on 3-day old unfed female mosquietoes. There was some cross-resistance apparent between the OP and carbamate insecticides.

----------, **AMRASCA BIGUTTLA BIGUTTULA (ISHIDA), COTTON, OKRA, RESISTANCE**.

3. **MAHAL (MS) and SINGH (B).**: Inheritance of Resistance in Okra to the Cotton Jassid Amrasca Biguttula Biguttula (Ishida) I. Field studies. Indian Journal of Entomology. 44,1; 1982; 1-12.

The resistant varieties of Okara, Abelmoschees esculentus (Linn.) Moench., either harboured low population of the cotton Jassid, Amrasca biguttula biguttula (Ishida) or exhibited less damage than the susceptible varieties (Bindra & Mahal, 1979; Mahal & Balraj Singh, 1979; Sandhee et al., 1974; Uthamasamy et al., 1973). The knowledge of mode of resistance is helpful in a programme of varietal improvement. Such an information was, however lacking in the case of okara varieties. This paper deals with the mode of inheritance of Jassid resistance in Okara and to suggest a suitable breeding programme for incorporating resistance.

----------, **RESISTANCE, AMARCA BUGUTTULA, BRINJAL LEAFHOPPER, NEEM, RESISTANCE, COMPARATIVE EFFICACY OF-**.

4. **SRINIVASAN (G) and SUNDRA (PC):** Comparatice efficacy of neem products against brinjal leaf hopper, Amrasca biguttula *Journal of* Agricultural Entomology: 62, 1;2000; 18-23.

Leaf hopper, Amrasca biguttula biguttula Inshida is the serious pest of various vegetable crops like brinja, Okara and cucurbits. Nymphs and adults sucki the Sap from the leaves of original and in severely attacked plants their growth is arrested and consequently the yield is considerably reduced. Organophosphates, Carbomates and Synthetic pyrethroids have been recommended against this pest. The present investigation were undertaken to evaluate the efficacy of some neem formulations against the leafhopper on bringal. A field experiment coas conducted to field out the efficiacy of certain neem products against brinjal leafhoppe, Amrasca biguttula biguttula Ishida Popular ev. Coz was selected and a total of three spraying were given at 15 days internal during the experimental period. The neem products tested gave effective control of A. biguttula biguttula nymphs. The mean population of leaf hopper myphs after three sprays in various treatments ranged from 1.44 to 3.44 as against 8.55 in control.

----------, ANTHERIGENA SPP., MAZIE GERMPLASM RESISTANCE:

5. **RAMACHANDRA (K) and PANWAR (VPS).** Location of sources of Resistance Amongst different maize Germplasm against the Atherigona spp. is spring season. Journal of Insect Behaviour 61, 2; 1996; 20-23.

The continuos cropping of maize in three seasons, manely Kharif, Rabi and Spring led to the emergence of changed pest complex in maize. The shoot fly spp. known to be serious pest of sorghum during kharif are now devastating maize in spring reason.

The identification of sources of resistance amongst indigenous maize germplasms to Atherigona spp. was imminent, with thus in view the various maize lines were subjected to heavy incidence to shoot fly complex in nature. The much needed pest resistance sources amongst maize germplasms if any would thus be identified.

----------, APHIS CRACEIVORA, BEAN, RESISTANCE, DEVELOPMENT.

6. **DHINGRA (S):** Development of resistance in the bean aphid, Aphis craceivora Kocu to various insecticides used for nearly a quarter ceutury. Annal Review of Entomology. 18,2; 1994;105-08.

This article deals with the development of resistance in the bean aphid. The toxicity of insecticides which have been commonly used in India during the last 25 years was evaluated

against Aphis craceivora, Myzus persical and lipaphis crysemi to determine levels of susceptibility. The LC50s of malathion, dimethoate, phosphamidon, methyl demeton, lindane, pyrethrins, endosulfan, fenitrothion, methyl parathion and nicotine sulfate increased by 46-24, 22, 21-20, 15, 14, 12, and 9 times. Myzus persical was more lipphis crysimi was more susceptible than Aphis craceivora to all 10 insecticides tested. Whereas lipaphis crysimi was more susceptible than A. Craceivora, except to parathion methyl.

----------, ARACHIS HYPOGAE, AOPOAEREMA MODICOLLA, LEAFMINER, RESISTED.

7. **RAO (Satyanarayan).** Resistance to leafminer APPROA-EREMA MODICELLA in ground ARACHISHY-POGAEA. Indian Journal of Agricultural Sciences. 63, 3; 1999; 28085.

This article deals with the Resistance to leafminer field screeming carried out to identify sources of resistance to groundnut leafminer. Aproaerema modicella in 41 genotypes using the visual damage rating system indicated that all of them were susceptible to GLM. However when the yield parameter was included, it was found that genotypes NC AC 17090 performed better in both damage rating and the yield, while the yield of the rest of genotypes was less than that of the check TMV2. Pubescent genotypes like NC AC 2230, NC AC 2214 and NC AC 2242 were found to have higher egg load than the glabrous genotypes. Visual damage rating has good negative

correlation with yield. The cumulative performance rating system might be useful in identifying the resistant tolerant and susceptible genotypes under very high levels of pest incidence.

----------, **ARGENTINEAN BLACK FLIES, DDT, PHYRETHROIDS, RESISTANCE:**

8. **CRISTINA (M), ANGUIANO (Alga), GAUNA (Lidia) and PECHEN (Ana M.):** Resistance to phyrethroids and DDT in a field-Mixed Population of Argentinean Black flies. Journal of Economic Entomology: 92, 6; 1999; 1243-45.

This article records the detection of pyrethroid and DDT resistance in Black fly populations. There are at least 5 insecticides appellations in each growing season, including the organophates arinphosmethy formet, dimethoate the cabernet carbary and the phrethroids cypermethrin and deltanethin. The drastic increases in simulid population in the last referral years could be the result of development of resistane to the insecticides currently used in fruit production. Cases of resistance to DDT and organophosphates were reported for simulium spp. so that the new cases of insecticide resistance in black flies, probably because of the saccess in the onchoerciasis control program with the use of bio-pesticides and rotations.

----------, **ATRAKON, TORTRIX, RESISTANCE PHENOROME MONITORING.**

9. **PRAYA and BUROV (VN):** Pheromore monitoring of totrix resistance to insecticides. Journal of South-China Agricultural University. 9,2; 1994; 21-22.

A method developed in the USSR for monitoring resistance of tortricids to chemicals involving the use of Atrakon. A traps coutaning specific pheromone and an insert in which the pestifix adhesue has been treated with the chemical at one of the range of concn LD50s are calculated from the results obtained separate laboratory tests indicated that independently of species or population susceptibility the larual have 10 times the sensitivity of the adults use of the methods in orchards in the krasmodar region indicated considerable development of resistance of the codling moth to Dursban, Ricord and phosalone.

----------, BACULAVIRUS, DEVELOPMENT.

10. **BONNING (BC) and HAMMOCK (BD).** Development and potential of genetically engineered viral insecticides. Entomological News, 10;1992; 455-89.

The topics discussed in this review include considerations (advantages and disadvantages) for the use of baculoviruses as enjgineered viral insecticides production of a recombinant baculavirus, genetically engineered viral insecticides developed to data bioassay of genetically engineered baculoviruses risk

assesment for genetically engineered baculovirus insecticides and potential of genetically engineered viral insecticide.

----------, **BHINDI, ABELMONCHUS, APHIDS, RESIDUAL, TOXOCITY OF-.**

11. **BODHADE (SN), NARKHEDE (PW) and BORLE (MN).** Residual Toxicity of Different Insecticides Against Aphids on BHINDI, ABELMONCHUS ESCULENTUSMOENCH. Journal of Applied Entomology. 54,1; 1992; 20-6.

The use synthetic pyrethroids has been enhanced owing to its quick down effect low mammalian toxicity, persistence, safety to parasites and predators etc. (Elliot et al., 1973; Lhoste, 1977; Waddill 1978) Sarup and his associates (1969) assessed the relative residual toxicity and persistence of several O.P. compounds and carbomates agaisnt sugar caneleaf hopper, Pyrilla purpuilla wilk. However, a little is known about the inherant toxicity, persistence etc. of the sysnthetic pyrethroids. An attempt coas therefore, mode of evaluate some of the pyrethroids and other insecticides for their relative residual toxicity and persistance using aphid, Aphis gossypii Glover on Bhindi, as test insect.

----------, **BRINJAL, BEMISIA TABACI, GENADIUS, WHITEFLY, NEEM, PRODUCTS, FIELD EVALUATION OF .**

12. **SRINIVASAN (G) and SUNDABA BABU (PC).** Field Evaluation of Neem Products Against Whitefly, Bemisia tobaci Gennadius on Brinjal. Annals of Plant Protection Sciences. 9, 1; 2001; 19-21.

Whitefly, Bemisia tabaci (Gennadius) is one of the serious pests of various vegetables crops like bringal, tomato, cueurbits and lady finger. Several authors reported the use of the neem and its derivatives for the management of sacking pests on brinjal. Fluit and Parks (1989) and Puri et al (1991) reported that neem seed kernal extract (NSKE) and commercial neem products were effective against B. tabaci. The present field studies were carried out to evaluate the efficiency of NSKE and some commercial neem products against B. tabaci on brinjal. NSKE 5% and neem product like Neem Azal T/S, Neem Azal F, Nimbecidine, Nem Cold, TNAU neem product No. 60 EC©, TNAU neem product 0.03% EC and Indneem were tested against the whitefly, Bemisia tabaci on brinjal. Standard insecticide endosulf 0.07% was also compared. All the neem products tested gave effective control of B. tabaci. However, Neem Azal F, Nimbecidive, Neem Gold and NSKE 5% performed better than other treatments recording lower mean population of 0.1, 0.4, 0.6 and 01 as against 5.7 pr five plans in control after three rounds of spraying.

----------, **BROWN PLANT HOPPR AND WHITE BACKED PLANT, HOPPER, RESISTANCE, MONITORING SUSCEPTIBILITY.**

13. **MAO (LX) and LIANG (TX).** Monitoring Susceptibility of white backed planthopper and brown plant hopper to thirteen Insecticides. Annals of Entomological Society of America. 6,2; 1992; 70-6.

The susceptibility of the delphacids sogatella purifiera and Nilaparviata lugens to 13 insecticides was studies in the laboratory strains of both species were most susceptible to carbofuran and least susceptible to malathion. The LD501, fluctuated between years due to migration. The development of resistance was faster in populations of relationship between resistance of populations of N. lingens and the chemical used. Locally. Monocrotoplos was more than 10 times as toxic as malathion.

14. **NANDA (UK) and RATH (LK).** Bio-chemcial Basis of Resistance in Rice to the Brown Plathopper NILAPARVATA LUGENS. *Bulletin of Eutomelogical Research.* 62, 3; 2000; 239-411.

Laboratory estimation of amino-acids in leaf sheathe of different rice varieties of 30 and 45 days old plants indicated that the resistance rice varieties had low level of aminoacid percentage varying from 5.27 to 9.37 compared to 8.12% in

susceptible TN1 in 30 days old plants whereas this phenomenon was not observed alike in 45 day old plants. The total soluble sugar content was the similar trend was not observed in 45 days old plants in comparison to resistant varieties. Low total free amino acid and total starch content could be considered as the contributing facts of differential variety resistance of the varieties of brown grasshopper.

----------, BUD-FLY, LINSEED, RESISTANCE PHYSIO-CHEMICAL.

15. **MALIK (YP), SINGH (SHASHI) and SINGH (B).** Determination of Physio-chemical Basis of Resistance in Linseed for Bud-Fly. Journal of Applied Entomology. 57,3; 1995; 267-73.

Fifteen linseed varieties viz Neelum, Hira, Mukta, Sweta, Shubbra, T. 397 Laxmi-27, Garima, Gaurav, Himalini, Chambal, Neela, Kiran, Jawahar 23-10 and R-552 were sown of 6th and Ist Nov during 1989-90 and 1990-91 respectively, in 5 x 4m plot size replicated thrice to see impact of phenotypic characters of the varieties and biochemical traits as leaves as well as seeds on the bud fly infestation the crop was raised under all agronoimical practices without any insecticidal application.

The Evolution of resistant genotypes may be persistent solutioin for management of most of the noxious pests inseed

crop could not get much attention in this direction therefore efforts are being made to determine the Physico-Chemical basis of resistance in linseed against its key-pest Dasyneura line Barnes.

----------, CABBAGE, DIAMONG BACK MOTH, BIOEFFICANCY.

16. **NAGESH (M) and VERMA (Shashi).** Bioefficancy of certain insecticides against Diamong back moth on cabbage. Journal of Insect Behaviour. 59, 4; 1997; 411-14.

One of the important factors responsible for the low productivity of cabbage in India due to the attack of diamond back moth to determine the comparative efficacy of certain Eco-friendly pesticides (viz. Neem, Bacillus thuringienses difflubenzuron and cartap) and synthetic organic insecticides endossulfan, chlorpyrifos and cypermethrin) against the diamond at IARI, New Delh. Hence a sequential spray with these chemicals of different modes of action can be recommended to solve the problem of development of resistance in the above pest. Profitable fields were also recorded in these treatments.

----------, CALLOSOBRUCHUS CHINERSIS, GRAM VARIETIES RELATIVE RESISTANCE.

17. **SINGH (VN), PANDEY (ND) and SINGH (YP).** Relative Resistance of Gram Varieties to Callosobruchus Chinensis Lim. On the Basis of Biochemical Parameters. Indian Journal of Agricultural Sciences. 57, 2; 1995; 77-82.

Gram is an important pulse crop and stored for future consumption as it has various uses in our daily meal. The grain damage in great extent during storage caused by callosobruchus chinensis is not only in terms of quantity, but also in quality of food grains (Gupta et al., 1981, Gujar, and Yadav, 1978). Chemical characters of the grain can play a vital role to find out the resistant varieties against infestation growth and development of the pest. Many workers (Podolar, and Applebaun, 1971; Epino and Morallo, 1983; Bhatia and Sethi 1989 studied the effect of Biochemical characters of various crops in relation to insect infestation.

----------, **CALLOSOBRUCHUS MACULATUS, COWPEA,** development of-

18. **AYAD (FA) and ALYOUSEF (EF).** Development of resistance to some insecticides in the cowpea weevil callosobruchus moculatus. Bulletin of Entomalogical Research, 19, 1; 1999; 19-21.

The rate of developmkent of insecticide resistance in the bruchid callosobruchus macutatus was studied under laboratory conditions. The results showed that the insect acquired

moderate and high leveels of resistance to alpha-HCH and chlordance respectively. Selection with bromophos ethyl, pirimiphos methyl, carboryl and permethrin was not effective and the insect did not acquire resistance of any of them.

----------, CALOCORIS ANGUSTATUS LETH, SORGHUM, SEED COAT and GLUME TOUGHNESS.

19. **RAMESH (P).** Seed-coat and Glume Toughness: A possible source of Resistance in sorghum to the sorghum Earhead Bug, calocoris Angustatus Leth. Indian Journal of Applied Entomology. 54, 3; 1992; 266-74.

The quality of food in general influences the feeding responses of animals. Dogget, evaluated several sorghum varieties for resistance to grain weevil and come to the conclusion that the thickness of the corneous endospherm layer of the seed was inversely correlated with the grain weevil damage. Similarly Sinha and Vosay reported that the resistance of some cereals and soil seeds to stored grain insect was due to mechanical barrier provided by the seed-coat particularly the tests surrounding the endosperm of the seed. Al the ICRISAT centre over 10,000 sorghum germ plasm have been evaluated against calocoris angustatus leth resistance of which 5 times viz 152761, 1817645, 189692, 156989, 1823061 were found lees susceptible.

----------, **CARBID BEETLES, BLACK CUTWERM, LARIAC,TOXOCITY,CONTACT and VOLATILE:**

20. **REED (JP), HALL (FR) and KRUEGER (HR).** Contact and volatile toxicity of insecticides to black cutworm larvae (Lepidoptera Nactuidae) and Carabid beetles (Coleoptera carabldae) in soil. Entomologial News: 85;1; 1992; 256-61.

The field plot studies conducted in ohio, for 3 years in conventional and non-tillage conditions to assess the contact and volatile toxicity of the granular soil insecticides Chlorphyreps, DPX-43898 (0,0-diethyl 0-2, 2, 2-tetrachloroethyl phospherothioate), jonofos and terbufos against 4 inster larvel of Agrotis ipsilon and adult carabids. Abnormally high perception and low soil temperature hindered acquisition of a lethal does by A. ipsilon from insecticide granules. Image analysis indicated that percentage contact area may contribute to differences in acquisition of soil insecticides by tarvae of A. ipsilon and its 2 most abundant carbid predators Abacidus permendus and pterostichus chalcites-organophosphate insecticides active at the kilogram per hectare level in soil and possessing high vapour pressures (>10M Pa) were poor candidates for control A. ipsilon and contributed to a reduction in endemic carbid popultions.

----------, **CASTANEUM, BEETLE TRIBOLIUM, RED FLOUR, DELTAMETHRIN, CROSS-RESISTANCE.**

21. **SAXENA (JD) and SHARMA (SR),** Cross Resistance spectrum of a laboratory selected Deltamethrin Resistant Strain of Red Flour Beetle, Tribbolium Castaneum (Aerbst.) Indian Journal of Applied Entomology. 57, 2; 1995; 116-19.

Ten Insecticides which included three synthetic pryethroids, two organochlorines four organophosphates and a funigant were evaluated. All the Insecticides used in the experiments were of technical grades except lambda cyhalothrin which was taken as 5 percent emulsifible concentrate Phosphine gas was prepared by decomposing celphes (3 g) Tablet. All the insecticides were bioassayed by topical application and the method of fumigation by phosphine was the same as described by Pradhan and Govinda (1958) Further selection of the deltamethrin-resistant strain was done trhough insecticide treated flour media method, as followed earlier by Saxena and Sinha. Adeltamethrin-resistant strain of Triboleum casta (Hearbst.) having aresistance factor of 891 was developed after six generations of selection (Saxena and Sinha, 1992, in process). This strain was further selected for two generations and studied for its cross resistance characteristics.

----------, **CEREAL APHIDS, RESISTANCE, STUDY ON**

22. **SEKUN (NP), KUDEL (KA) and SATSYUK (OS),** Study on potential resistance of cereal aphids to insecticides. Environmental Entomology. 37, 5; 1990; p. 49-53.

Field populations of cereals aphids from the Mascow region and various regions of the Vkrainion were examined for resistance to currently applied and new insecticides, and artificial selection of aphid races for resistance of insecticides was undertaken under laboratory conditions. Differential respnsiuenjess of schizapphis graminum and Rhopalasiphum padi to multiple treatments with insecticides was demonstrated. No graminum populations resistant to organophosphorus insecticides were found, whereas certain R. pudi population showed 30 fold resistance to organophosphorus insecticides and 25 fold resistance to pyrethroids. Methods to slow down the development of resistant pest populations are suggested.

----------, CEROPLASTES FLORIDENSIS, FLORIDAWAS, FIELD PERFORMANCES.

23. **ABDEL-MEGEED (MI), HELMY (EI) and EL-IMERY (SM),** Field performances of certain insecticides on the Florida wax scale insect, ceroplastes floridensis comst infesting citrus in Egypt. European Journal of Entomology. 17, 19; 1988; 196-201.

Seven Insecticides were lested against ceroplastes floridensis on items in Egypt on mandrins, marathon and fenitrothion were the most effective followed by Kzoil (4). Phytotoxicity was highest for KZ oil (4), followed fin decending order of phycotoxicity) byquinalphos in oil, fenitration toil, phenthoate fenitration, prothiofos and

malathion. On grape fruits, fentitration, quinalphos in oil KZ oil (4) and phenthoate gave satisfactory resutls against the coccid. The decanting order of phytotoxicity was KZ oil (4) quinalphos in oil, phenthoate, fenitration and prothiofos.

----------, CHEMICALS, CEROPLASTES FLORIDENSIS, CEROBLASTS, WAS FIELD.

24. **AMITAI (S).** Wax Shield of Ceroplastes Floridensis as a barrier to Insecticides. European Journal of Entomology, 46, 9; 1992; 607-11.

The formulation of the wax shield in adult females of ceroplastes floricensis was investigated. During maturation of the scale and before oveposition, the production of the wax layers occurred mainly on the margin of the ventral side of the body which then becomes attached to the surface of the leaf or tring the scale is thus protected from the penetration of insecticides in the late stages of adult development.

----------, CHEMICALS, HELICOVERPA ARMIGERA, RELATIVE RESISTANCE.

25. **PATEL (CC), BORAD (PK), BALOLIYA (KF) and PATEL (JR).** Relative Resistance to conventional synthetic Insecticides in Helicoverpa (Heliothis) Armigera Hubner in Gujrat. Journal of Agriculture of Entomology. 62, 4; 2000; 358-62.

An experiment was conducted at Gujrat Agricultural University, Campus Anand to determine the level of resistance

developed by Helicoverpa (Heliothis) armigera Hubner populations to conventional synthetic insecticides of Gujrat State during 1998-99. The population of Kayavaroharn (Distt. Vadodara) and Bayad (Dist. Sadar Kantha) areas were tested against nine different insecticides. Cypermethrin quinalphes, Chlorpyriphes, fenvaterate and carbaryl were found at more than 10 folds level of resistance in H. armigera for both the locations.

----------, CHEMICAL, MOTH, TORTRIX, PHEROMONE MONITORING.

26. **DORMAN (DC) and BEASLEY (VR).** Pheromone monitoring of tortrix resistance to insecticides. Environment Entomology. 39, 9; 1991; 21-22.

A description is gives of amethod developed for monitoring resistance of tortricids to chemicals involving the use of Atrakon. A traps containing specific pheromone and an insert in which the Pestifis adhesive has been treated with the chemicals at one of a range of concn separate laboratory tests indicated that independently of species or population susceptibility, the larvae have 10 times the sensitivity of the adults use of the method in archers in Krasnodar region indicated considerable development of resistance of the codling moth of Dursban Ripcord and phosalone.

----------, **CHEMICALS, MUSCA DOMESTICA, MONITORING, HUNGARY.**

27. **PAPP (L) and FARKAS (R).** Monitoring of resistance of insecticides in housefly (Musca domestica) populations in Hungary. European Journal of Entomology, 40, 4; 1994; 2145-58.

To determine the susceptibility of housefly on different type of insecticides: organochlorines, organophosphates, Carbonates, pyrethroids, macrocylic lactone and insect gorwth regulators. The adulticides were tested with topical bioassy in all 24 populations. The data were expressed as LD50 values (ng fly-1 and mg Kg^{-1} Larval medium respectively. The percentages of populations which had resistance ratios > 10 at LD 50 or LC 50 were: 63% to DDT, 50% to Melthoxychlor, 13% to lindone, 83% to malathion, 63% to trichlorfon, 4% to propetamphos, 96% to dioxacarb, 46% to poropoxur, 4% to 58% to cypermethrin 79% to SK-80, 79% to deltamethrin, 38% to invermectin, 0% to diflubenzuron, 0% to cyromazin. Carrdation showed except some. No cross resistance was found between the larvicides and the conventional adticides. Differences of insecticide resistance levels among the analysis. In this high resistance was shown to most chemicals.

----------, **CHEMICALS, MYLABRIS PUSTULATA, DETECTION.**

28. **DHINGRA (Swaran) and PRAKASH SARUP.** Detection of resistance in the blister battle, Mylabris pustulata thumb to various insecticides evaluated during the last quarter century. Journal of Entomologial Research. 16, 3; 1992; 231-35.

This articles deals with the detection of resistance in the blister beetle. Lambdacyhalothrin, alphamethrin, decamethrin, cypermethrins, fenpropration were respectively more toxic than lindane. A comprison of LC50 values for commonly used and recommended insecticides determined during the last quarter clutury. There was about 18.1, 2.6 and 1.5 times increase in the LC50 values of these insecticides. On the other hand toxicity of pyrethrin to m. pustulata remained more or less the same, response of M. pustulata to pyrethrum did not change. The toxicity of othyer commonly used insecticide carbaryl to M,l pustulata did show 3.19 fold resistance after a lapse of about 25 years. Evidence of development of resistance in M. pustulata to synthetic pyrethroias, carbamate, organophosphates and chlorinated hydrocarbans was thus experimentally obtained.

----------, **CHICKPEA, *HELIOTHIS ARMIGERA*, DISSIPATION PERSISTANCE.**

29. **RAVI (G) and VERMA (S).** Persistence and Dissipation of Insecticides Against Heliothis Amigera On CHICKPEA. Indian Journal of Agricultural Sciences. 59, 1; 1997.

Chlorphyrifos 0.05% gave maximum reduction in larval population on treated crop in the field followed by finvalerate, endosulfan and diflubenzuron. The least effective insecticide was azadirachtin with 8.33 larvae 10 plants in comparison to 16.33 larvae in control. Two sprays are required to reduce the brval population. Use of mixtue of diflubenzuron with chlorpyrifos or endosulfan can be recommended for the control of H. armigera, as it gave good control of the pest and also showed safe selective action against its larval parasitoid C-chlorideac. The safe interval for chlorprifos endosulfan and diflubenzuron on the basis of residues on chick pea should be followed as 2, 4 and 6 days respectively for the consumption of green plants.

----------, CHILLIES, APHID MYZUS PERSICAE, evaluation of-.

30. **KANDASAMY (C), MOHAN SUNDARAM (M) and KARUPPUCHAMY (P).** Evaluation of insecticides for the control of the aphid myzus precise on chilies. Madras Agricultural Journal. 76, 12; 1989; 707-09.

Development of resistance to insecticides by Myzus persicae has made cultivation of chillies uneconomical. Dichlorvos, monocrotophos, endosulfan, triazophos, phosalone, methylo demetion and carbosulfan were sprayed onto field plots and their effectiveness compared. Carbosulfan (0.04%) caused

the greatest reduction in numbers but demetion-0-methyl (0.025%) was most cost effective.

----------, CHILO PARTELLUS, ANTHERIGONE, MAIZE GERMPLASM, evaluation of-.

31. **PANWAR (VPS) and SHARMA (RK).** Evaluation of maize Germplasms for locating Multiple Resistant sources to chilo partellus and Atherigone. Annual Review of Entomology. 60,2; 1998.171-76.

This articles describe about the multiple Resistant sources to Chilo partellus. Fifty eight maize germplasms comprising medium maturity and full-season maturity were evaluated for resistance to tissue borers, the maize stalk borner, chilopartellus under factitious release of egg masses during Kharif and the shoot fly species under heavy natural infestation during spring season. The reactions of maize germplasms to the tissue borers during Kharifs as also in spring season led to their categorizations into three distinct groups. The varieties of third category could be designated as multiple resistant to tissue borers. C. partellus and Atherigona spp. their fudicious utilization will immensely help to develop maize cultivators resistant to pests with other agronomic traits.

----------, ----------, MAIZE STALK BARER, SUBLETHAL, effect-of.

32. **SINGH (JP) and MARWAHA (KK).** Effect of sublethal concentrations of some insecticides on growth and development of maize stalk borner, chilo partellus (Sunrinhoe) larvae. Journal of Entomological Society of British Columbia. 7,2; 2000; 181-6.

In the Lab when studies were carried out to see the effect of four insecticides, cypermethrin, Phosphamidon, guinalphos and endosulfan, on growth and development of maize stalk borner, chilo partellus (swinhee) larvae after exposing one and five days old (1st and 2nd instar) larvae for half an hour to the residual film of different, concentrations (LC20, LC 20 and LC 80) of insecticides Although the subtelhal/concentrations of all the four insecticides adversely affected the percent larval survival, percent population, percent moth mergence, fecundity and viability of eges, deformity in moths and greatly prolonged the larval and developmental period. One day old larval were comparatively more susceptible to these insecticides as compared to five days old larval.

----------, CHILO PARTULLUS, MAIZE STALK BORER, FRESHLY HATCHED LARVAE, MAIZE LEAVES, INSECTICIDES, TOXICITY, RESIDUAL, PERSISTANCE.

33. **SINGH (JP) and MARWAHA (KK).** Persistence and Residual Toxicity of Insecticides on Maize leaves/whorls Against Freshly Hatched larvae of Maize stalk borer, Chilo parlellus (Swinhse). Environmental Entomology 57, 3; 1995; 213-18.

The Maze stalk borer is the key pest of maize and berghum in the field and is one of the limiting factors in attaining the increased productivity of maize since the borer attacks the early stage (10-22 old) crop obviously the vulnerable stage of maize be protected with insecticidal application for effective suppression of borer population in the field. For the effective and economical control of stalk, borer with insecticides it is imperative to study their persistence, and residual toxicity in terms of duration of effectiveness before recommending their use. The four Insecticides viz. Cyper methon quinalphes, phosphanidon and endosulfan were evaluated for bluration of effectiveness on the basis of T and LT50 values. The results emanating from such investigation are reported in this contribution.

----------, ----------, STEM BORER, SOCCATA-RONDANI, ATHERIGONA, SHOOTFLY, SORGHUM GERMPLASM, DEVELOPMENT.

34. **PREM KISHORE.** Development of new dual purpose sorghum germplasm showing resistance to shootfly, Atherigona soccata Rondani and stem borer, Chilo partellus. Bulletin of Entomological Reseach. 18, 32; 1994; 279-81.

Six dual purpose sorghum cultivars (DS-1 to DS-6) showing resistance to the shootfly and stem borer have been developed through several cycles of selection from moderte x moderate resistance crosses. Their field performance was tested along with released fodder varities viz PER CENT-6, PER CENT-9, PER CENT-23 and grain hybrid CSH-1 for shootfly and stem borer resistance as well as ffro various quality parameters. It is evident that all the sorghum lines, viz. DS-1 to DS-6 were better than standard checks PER CENT-6, and PER CENT-9 as regards the average percent dead-hearts formed due to shootfly and stem borer.

----------, CISTELLATA BUCKTON, APSYLLA, BIOLOGICAL OBSERRVATIONS AND CONTROL.

35. **SINGH (G).** Biological observations and control of Apsylla Cistellata Buckton (Psyllidac "Homoplea). Bulletin of Entomology). 37, 1; 1975; 46-50.

Aspylla cislellata causes formation of cone shaped galls in the leaf axils of magnifera indica the mango. In view of its serioussness, life history causes of agall formation assesment of damage and control of this pest engaged the attention of

various, coorers (Mathur, 1946, Prasad, 1957, Singh 1959; Gupta and Haq 1958; Singh 1954, 1959b, 1960). Inspite of these studies, the causes of gall formation remained unknown. Also most of the known control measures are obsolete and unsatisfactory. The aim of the present studies therefore was to probe into the intricacies of gall formation and to devise a suitable control for the formation of galls by A. cistellala.

----------, COCKROACH, SPECIES, DEVELOPMENT.

36. **EL-REFAI (A).** Toxicity of some insecticides to the development stages of cockroch species. European Journal of Entomology. 33,2; 1991; 36-8.

To toxicity of [Chlorpyrifos], diazion pesquard [the (IR)-cis trans isomea of phenothrin] and chlordane were evaluated against adults, nymphs and oothecae of Blattella germanica and Periplaneta americana by the immersion technique. For any developmental stages examined, the order of toxicity at LD50 level was susceptibility of the various stages was othecae 7 nymphs > adults in formulations when different ages of cockroch oothecae dipped, of these insecticides, oil base formulation showed higher ovicidal activity than their corresponding emulsion emulation oolthecal susceptibility decreased with ages of all formulations.

----------, COLORADO POTATO, RESISTANCE, PREVENTION, INVESTIGATION, POLND.

37. **WEGOREK (P).** Prevention of colorado potato beetle resistance to insecticides. Vegetables Science. 39, 7; 1995; 45-47.

This articles describes about the potato bettle resistance to insecticides. Investigations in Poland under the auspices of the Inseccticide Resistance Action Committee of the Groupement International des Associations National de Fabricates led to the issuing of recommendations by the working group on Agricultural and Horticultural crops for a strategy aimed at counteracting the development of resistance to insecticides in the colorado potato bettle.

----------, CORCYRA CEPHALONICA, DIFLUBENZURON, INFLUENCE-OF-.

38. **GUPTA (M) and GUPTA (PK).** Influence of diflubenzuron in producing resistance to corcyra ceplatonica st. Environmental Entomology. 56, 3; 1994; 308-10.

Toxicity differences among lepidopterous species exposed to benzophinyl limense vast some species like tussock moth pseudotsugata on the coutrary some species such as spruce budworm fumiferana and western spruce budworm C. occidental is exhibited tolerance to extent of 1500 times. During the present study mothe were obtained from the normal strait of C., aphalonica which is bieng maintained in the laboratory of sorghum and 5 percent yeast powder at $30+2^{0}$C and 70+5%. RH

solutions of diflubenzuron (0.6.10.5, 0.5 and 0.3%) were prepared in acetone and the desired concentration of the chemial was appleid topically on the abdominal sternum of freshly emergea adults in the manner. The results obtained show that the species is likely to develop resistane to diflubenzuron if selected for few generation. It is quite obvious from the results obtained that C-cephatonica is capable of developing resistance to diflubenzuron which is so far not widely lemployed to control the agricultural pest species.

----------, CORCYRA CEPHALONICA, SORGHUM, ANTISUNOSIS AND ANTIBIOSIS.

39. **PRAMOD KUMAR (K) and DHARMA REDDY (K).** Antisunosis and antibiosis components of Resistance in sorghum to the Rice moth, corcyra cephalonica. Indian Journal of Agricutlural Sciences. 44, 6; 1998, 63-5.

Thirtyfive grain sorghum genotypes comprising 6 groups were evaluated for resistance to rice, mouth, corcyra cephalonica in terms of antinenosis for larval colonization and antibiosis on larval survival and weight, population and adult emergence. High levels of antixenosis was noticed on 296B, AKMS 14A, SPU 86, Swati 189487, 11758 may be due to insufficient or deficient nutrients available in their reflecting high degree of antibiosis. Significantly low seed damage and less seed weight less was noticed. On the contrary M35-1, CSU 8R DJ 6514 and 2077A were found highly susceptible in terms

of greater seed weight loss both in free choice and no choice tests.

----------, COTTON, ARTHOPODS, NEEM, IMPACT-ON.

40. **NATH (P) and SINGH (AK).** Impact of Neem Based insecticides on Beneficial Athropods in cotton Eco-system. Annual Review of Entomology. 9,2; 2001; 225-29.

The effect of neem formulations based on azadiracthin content was evaluated against beneficial arthropods in cotton agro eco system, Parasilization of Bemisia tabaci by Encarsia spp. in neem based insecticides was recorded to be minimum (41%) in Rakshak Gold 21/ha which was at par with control determinental effects with 0.86% parasitization. Number of spiders 15 plants were recorded significantly maximum (5.00) with Neem Azal 1/ha than that of control (3.00) where as thriazophos proved highly toxic with 0.33 spider. The population of coccinellids /15 plants proved highly toxic after recording to be of maximum 3.32 in Neem Azal.

----------, COTTON BOLLWARM, RESISTANCE MANAGEMENT.

41. **YANCHO (J), GUILIN (C) and RUNXI (L).** Resistance management of cotton bollworm with mixtures of insecticides. Environmental Entomology. 7,1; 1995; 10-13.

The articles deals, with the Resistance management of cotton bollworm, the multiple resistance to mixtures of

deltamethrin, methomyl and phoxim, thiodan [endosulpan], deltamethrin and phoxim and deltamethrin, parathion and methomyl in a colony of Helicoverpa armigera collected from shandon province, china did not occur, when these mixtures were rotated, suggesting that the development of resistance could be delayed using this strategy.

----------, COTTON BOLLWORN, POLYPHAGOUS, NOCTUID PEST, India.

42. **REYNOLDS (D) and ARMES (N).** When Insecticides fails, the case of the cotton bollworm in India Journal of Entomological Society of British Columbia. 24; 1994; 39-92.

This article deals with when insecticides fail, some of the reasons for the development and spread of insecticide resistance in the noctvid pest Helicoverpa armigera in India are discussed with special reference to the role of movements of adults moths. New insecticide resistance management strategies are urgently required if further widespread failure to control this pest are to be avoided.

----------, COTTON JASSID, PYRETHROIDS, DETECTION OF RESISTANCE.

43. **MUSTAQ KHAN, IQBAL ARIF KHAN and ZAHOOR.** Detection of Resistance of Pyrethroids in field Populations of Cotton Jussid (Homoptera: cicadellidal) from Pakistan. Journal of Economic Entomology. 92, 6; 1999; 1246-48.

The article deals with the toxicity of 8 pyrethroids which was determined in adult population of cotton jassid during 1995-98 using a leaf dip method. There was very low jassid resistance to alphacypermethrin, fenpropathren, bifenthrin, lambdacyhalothrin and etofenprox Resistance to cypermethrin and deltamethrin was generally very low as well; but several populations did show a low to moderate level of resistance to these compounds and one population even exhibited a very high resistance to deltamethrin when the mortality was assessed after 24h. Moderate to high resistance was found to zetacypermethrin in 6 of 8 population tested. This development of resistance to some pyrethroids in the Pakistani population of jassid is is a serious cause for concern and there is need of effective management at the initial stage of development.

----------, COTTON PESTS, ORGANOPHOSPHATE, CARBOMATE, INDIA.

44. **KRANTHI (KR) and JADHAV (D.R.).** Carbamate and organophosphate resistance in cotton pests in India. Bulletin of Entomologial Research. 91, 1; 2001; 37-46.

Monitoring for organophosphate and carbomate resistance was carried on five major inset of cotto60n collected 22 cotton growing districts across India. Resistance was monitored in Helicoverpa armigera and Saunders for the period 1995-1999. Of the 53 fields strains of H. armigera, only four were found to exhibit resistance to quinalphos, the highest 15 fold whereas all

16 field strains tested were found to be resistant to monocrotophos. Similarly out of 40 field strains tested, only eight were found to express appreciable resistance to methyl. Resistance in P. gossypiella to quinalphos was high in the majority of the strains tested of the seven strain of E. vittella tested, two strains from northern India exhibited >70 fold resistance to monocrotophos. Of the 115 litura strains tested, only four were found to exhibit resistance factors of 10 to 30 fold to quinalphos and monocrotophos. All of the B. tabaci field strain exhibited resistance to methomyl and monocrotophos and susceptibility to triazophos. Practical implications for pest control resulting from the observed patterns of cross-resistance between quinalphos, monocrotophos and methomyl are discussed.

----------, COTTON RESISTANCE, TARNISHED PLANT FIELD POPULTION.

45. **SNODGRASS (GL).** Insecticide Resistance in Field Population of the Tarnished Plant Bug (Heteropetra : Miridae) in cotton in the Mississippi Delta. Journal of Economic Entomology. 89,4; 1996;783-88.

Adult tarnished plant bugs, collected in July and August from 4 cotton fields in the in the mississippi Delta with plant bug control problems were tested with a glass vial bioassay for resistance to insecticides. Resistance levels determined for the different field populations were compared with those found by

using the glass vial bioassy and susceptible palnt bugs collected from weeds near crossett, AR. The distribution of insecticide resistance in tarnished plant bug populations from the Mississippi Delta is unknown compliance with the insecticide resistance management plan currently recommended for control of the tobacco badworm. Heliothis virescens (F) is probably the best strategy for preventing the development of plant bug population with multiple insecticides resistance.

----------, COTTON, SUCKING PESTS, SPRAYINA, IMPACT OF-.

46. **LAL(R) and GUPTA (GP).** Impact of sprayina schedules on sucking pests in cotton system. Annual Review of Entomology. 60,3;1998;305-10.

Cotton the prime cash crop of India, receives more insecticides than any other crop. Six protection schedules for cotton bollworms were evaluated for their efficacy and their impact was studied on sucking insect pestes namely, Jassid and whitefly. These protection schedules consisted of convenient insecticides synthetic pyrethroids and biopesticides (neem and or Bacillus thuringiensis based pesticides) spraying schedule consisting with monocrotophos (500g/ha), deltamethrin (12.5g/ha), endosulfan (750g/ha), cypermthrin (60g/ha) and triazophos (600g/ha) proved most effective against the sucking pests in particular to Jassids.

----------, CYPERMETHRIN, MYZUS PERSICAL DEVELOPMENT.

47. **DHINGRA (Dwarn) and SINGH (DS).** Rapid development of resistance in Myzus persical sulz to cypermentrin. Bulletin to Entomological Research. 16, 4; 1992; 319-20.

The articles deals with the rapid development of resistance in Muzus persical sulz. Detection of development of resistance in Myzus persicae sulz to phosphamidon and synthetic pyrethroid cypermethrin was studied in the labortory. Response of the population of M. persical to insecticides showed LC50 values obtained during 1988 and 1992 revealed that M. persical had developed 5 fold resistance to cypermethrin. However, the aphid pest showed only 1.8 fold resistance to phosphamidon. This suggest that the development of resistance to cypermethrin ws rather faster as compared to phosphamidon.

----------, DELTAMETHRIN, PIOPHILLA CASEI STRAIN, DEVELOPMENT OF-.

48. **ROSSI (Elisabetta) and PRESCUTTINI (Silvano).** Development of Insecticide Resistance in piophilla casei strains selected with Dases of Deltamethrin. Journal of Economic Entomology. 89, 1; 1996; 15-8.

This article describe the trend of insecticide resistance development in 2 populations of the cheese skipper. The 1st came from a sheep farm where no inbsecticide was ever applied

the 2nd was collected in an industrial cured park manufacturing plant, where insecticides were periodically applied against other pests. A substantial difference between their resistance to deltamethrin was observed. (LC50=11.56 Versus 68.08 mg/cm^2 for females and 1.11 versus 4.20 mg/cm^2 for males, for males, respectively.

----------, **DETOXIFYING ENZYMES, SUSCEPTIBILITY.**

49. **CHAING (FM) and SUN (CN).** Detoxyying, eyzymels and susceptibility to several insecticides. Journal of Entomological Society of British Columbia. 20, 6; 1991; 687-90.

Detoxifying enzymes and susceptibility to 3 insecticides of Apanteles plutellae (Cotesia plutelxe) and Diadegma Semiclauseem, parasitoids of Larvae of Plutela xylostella, coere determined. Both insects were susceptible to malathion and methyl parathion (parathion methyl)] and were considerably tolerant to fenvalerate. Allthough the attempt to correlate this susceptibility with the blotoxication capabilities in terms of activities towards model substracts of in terms of activities towards model substrates of carboxylesterase, glutione s transfers and microsomal monooxygenase of these 2 parasitors was unsuccessful, the possibility of using this means to assess the pootential for development of insecticide resistance in natural enemies is discussed.

----------, DEVELOPMENT, OIL SEED RAPE, PEST INSECTS INVESTIGATION.

50. **BUCHS (W).** Investigations on the occurance of pest insects in oil seed rape as a basis for the development of action thresholds, concepts for prognosis and strategies ffor the reduction of the input of insecticides. European Journal of Entomology. 16,9; 1993; 216-34.

The use of insecticides or the control of insect pests on rape was studied in Germany during 1989-92. For Psyeliodes chrysocephala it was demonstrated that at different locations, even within a region, the main immigration peak occurred in a range of 4 weeks, the additional spray with a pyrethroid insecticide after mid october controlled p. chrysocephala, even if the immigration peak occurred a month earlier. Controhynchus palliodactylus and C. napi regularly showed 2 immigration peaks 14-2 days apart and their activity in the field increased 14 days after immigration. A 2nd immigration peak coincided with the immigration of either peasts. Spraying with pyrethroid insecticides in the had long lasting effects on other summer pests insects, so that one insecticide application in the spring at the 2nd peak of C. pallidactylus and C. napi was the most effective. Thius paper was presented at the 10 BC/WPRS working group one integrated control in oilseeds crops held in the Rhen, France, on 27-28 Feb. 1992.

----------, DIAMOND MOTH, DEVELOPMENT

51. **CHO (YS) and LEE (SC).** Resistance development and cross-resistnace of diamondback moth by single selection of several insecticides. Korean Journal of Applied Entomology. 33, 4; 1994; 42-9.

Studies were conducted to investigate the development of chemical resistance and cross-resistance in Plutella xylostella. A Bacillus thringiensis-selected strain at the 8th selected generation exhibited 24.0 fold resistance and the prothiophos - selected strain at the 8th generation revealed 14.3 fold resistant level. A cartap hydrochloride selected strain at the 8th generation showed a 9.1 fold resistant level. A prothiofos selected strain showed low cross resistance to ecartap hydrochloride, while this strain exhibited no cross-resistance to other insecticides. Triflumuron-selected stain showed 1.3-4.9 fold cross. Resistance to other insecticides. The B. thuringiensis-selected strain showed no. cross resistance to other insecticides.

----------, DIFLUBENZURON, SPODOPTERA LITTORALIS LARVAE, CHANGES.

52. **WASTON (WM), GUIRGUIS (MW).** Changes in susceptibility to insecticides of spodoptera littorales larvae selected with diflubenzuron and three conventional insecticides. Brighton crop Protection Conference, Pests and Disease. 40, 1; 1998; 445-50.

This paper was presented at a conference held in Brighton, UK on 21-24 Nov. 1998. The development of tolerance and cross-tolerance in larvae of the noctuid spodopetra littoralis to diflubenzuron, methomyl, profenofos and fenvalerate was studied. The level of tolerance to diflubenzuron and cross-tolerance between diflubenzuron and the other insecticides tested was relatively low. Further selection of methomyl, profenofos and fenvalerate tolerant strain with diflubenzuron during the 5th generation reduced the tolerance levels to conventional insecticides.

----------, DOUGLASFIR SEED, SEED INSECT, CONE, EXPERIENCES.

53. **SUMMERS (D), MILLER (GE) and ROQUES (A).** Experience with systematic insecticides for control of cone and seed insects in Douglesfir seed orchards in coastal British columbia, Canada. Entomological News 7,1; 1986; 267-83.

Three systematic insecticides were sereened experimentally, and 2 of them used operationally, against cone and seed insects (especially contarinia oregonensis, megastigmes spermotrophus and Barbara Codfaxiana), in seed orchards of Douglas fir (Psecidotsuga monziesu) on vancouver I, British Columbia, Dimethoate as a flair spray, controlled the pests and increased the number of filled seeds per cone making it the recommended choice. Oxydemeton methylasa foliar spray, was as effective as dimethoate in controlling the insects but appeared less effective

in increasing the number of filled seeds. Acepthate as a foliar spray was inconsiotent in the level of pest control achieved and as an injection gave poor results; its use was also associated with the development of serious outbreaks of Adelges coolegi [Gilleteela cooley].

----------, ECUADER, NEEM, EXPERIMENTS.

54. **WENDT (V)**. Experiments with neem insecticides in Ecuadar successful European Journal of Entomology 4, 90; 1990; 25-8.

The first phase (1987-1989) of the GTZ neem project in Ecuador (in cooperation with the Ecuadorian N60 CEMADEC (Centro Mahatiba de Desarrelo Communitario) has laid the biological foundations for the use of neem preparations as insecucides on annual crops in the project region. It has demonstrated that all the key pests can be controlled with neem preparations with the same degree of efficacy and the same number of applications as or chemical insecticides. The project has been extended for a further 3 years with the main emphasis for this period on improved neem seed harvesting, plating more neem trees, setting up the production of neem seed powder by artisans, and working out a concept of integrated pest management.

----------, EWNTOMOPHAGES, PESTS, SENSITIVITY.

55. **KOVALENKOV (VG) and TYURINA (NM).** Sensitivity of pests and entomophages to Insecticides. Journal of Entomological Society of British Columbia. 11, 193; 20-21.

Control of sucking pests of cotton in Tajikistan relies on the combined effect of chemicals and naturally occurring parasitoids and predators. The results are given of a study on toxicity and context and the results are given of a study on toxicity and selectivity of 10 organophosphorus and pyrethroid insecticides in relation to and Aphis gossypil and cochineal septempunctata in the Gissar Valley. Selectivity was found to differ from official levels recorded for susceptible populations, being evidently related to the resistance levels developed by the pest-perdition complex and usually showup a shift No Correlation was found between development of resistance in post and predator.

----------, EPIRICANIA MELANOLECUA, PYRILLA PERPUSILLA, SUGAR CANE LAFHOPPER, PYSILLA PERPUSILLA, EVALUATION OF-.

56. **TRIPATHI (GM) and KATIYAR (RR).** Evaluation of some Insecticides Against Sugar Cane Leaf Hopper, Pyrilla Perpusilla and its Ectoparasitoid EPIRICANIA MELANOLEUCA. Indian Journal of Applied Entomology. 60, 4; 1998; 391-95.

Sugar cane leaf hopper, Pyrilla perpusilla wlk. Is regarded as the most serious among the sucking pests of suggarcane.

Fouler application of chlorpyrifos, Malathion, Achoock, Dimethrin and Methyl-o-dimethrion caused the reduction in population of Pyrilla perpusilla coalkes to the extent of 80-76, 86.23, 27.30, 83.66, 84.60, 84.01, 82.30 (in 24 hr.) 97.86, 96.96, 46.36, 95.36, 96.56, 96.23, 94.66 (7 days) in 1994 and 86.96, 84.50, 25.96, 81.26, 84.10, 82.36, 80.76 (24 hr.) 98.13, 97.33, 46.60, 93.80, 96.96, 95.93 and 93.16 percent (7 days) during. The corresponding reduction in untreated control plots were 2.36, 3.73 and 2.20, 3.90 percent during 1994 and 1995 respectively. After 96 hours application of insecticides an increase in the no. of cocoons and egg masses and reduction in the lucidity (9.20 to 18.23%) of E. Melanoleuca F. were recorded during 1994-95. The overall performance revealed that endosulfan was most effective in respect to the pest centres as well as safety to the ecto parasitoid.

----------, ESPIRITO SANTODO PINHAL, ORANGE, SOIL SYSTEMIC, INFLUENCE OF-.

57. **CALAFIORI (MH), FORNER (MA).** Influence of soil systemic insecticides orange tree growth in Espirato Santo do Pinhal, sp. European Journal of Entomology. 13; 1988; 114-20.

The effects on the insecticides aldicarb and carbofuran on the development of orange trees CV (Pera) were examined on field studies in sao Paulo, Brazil, between 1984 and 1987 Aldicarb was applied at initial doses of 1, 2, 3 or 4 g a.i/plant per year and carbofuran was applied at 2 g a.i./plant per year.

Doses per plant were doubled each year. Effects on plant growth and fruit production were followed. The best results in terms of both tree growth and fruit production were achieved with applications of 2, 4 or 8 g a.i./plant per year of aldicarb in 2 doses.

----------, EUSEIUS TUBRENSIS, ORCHARDS, TOXICITY OF-.

58. **GRAFTON, CARDWELL (EE) and OUYANG (Y).** Toxicity of four Insecticides to various populations of the predacious mite, Enseius tularensis congdon. (Acarina: Phytoscidae) from San Joaquin Valley California Citrus. Annals of Entomological Society of America 10,1; 1993; 21-9.

Populations from orchards in which broad spectrum pesticide use had been discontinued showed an intermediate response. Thus, selection pressure appears to beafactor in the development of pesticide resistance in E. tularensis and resistance is relatively lo9calized. The insecticides used for control of scirtothrips citri appeared to be more toxic to E. tularensis than the insecticides used for conrol of Aonidiella aurantii and A. citrina. The resistant population of this mite should be useful for mass-rearing and release in orchard situations in the process of transition from a purely broad spectrum approach to an approach utilizing selective pesticides.

----------, **FALL ARMYWARM, CORN EARWORM, SWEET CORN, TRANSGENIC, EVALUATION OF-.**

59. **LYNCH (RE) and WISEMAN (BR).** Evaluation of Transgenic sweet corn Hybrids Expressing Cryla (b) Toxin for Resistance to corn Earworm and Fall Armyworm. Journal of Economic Entomology. 92, 1; 1999; 246-52.

Many of the Lepidopterous insects which attack sweet corn. Zea mays L. are suspectible to insecticidal proteins produced by Bacillus thuringiensis ssp. Kurstaki (Berlinsh) (Btk). Transgenic sweet corn expressing a synthetic cry gene for production of a Btk-insecticidal protein may provide a more environmentally acceptable means of sweet corn production. Laboratory tests revealed that all Btk sweet corn hybrids were highly resistant to leaf and silk feeding by neonate 3 and 6d old corn carworm larvae. Ear damage in the field to the Btk sweet corn hybrids caused by corn carworm was negligible. All Btk sweet corn hybrids, except Btk 95-0901, were moderately resistant to leaf and silk feeding by7 the fall arnyworm. With appropriate cultural practices, it is highly unlikely that Btk sweet corn will contribute to the development of resistance to Btk proteins in these insects because of the high toxicity of the cry proteins expressed in these sweet corn hybrids and the harvest of sweet corn ears from fields before larvae can complete development.

----------, **FENVALERATE, RESISTANT, TRIBOLIUM CASTANEUM, BIOLOGY OF-.**

60. **SUTTER (GR), BRANSON (TF) and ELLIOTT (NC).** Biology of Tribolium Castaneum strains Ressitant and susceptible to Fenvalerate. Journal of Kansas Entomological Society. 59,2; 1997; 224-27.

The intensive selection resulting in the development of resistance to insecticides has been observed to result in simultaneous segregation of other characters which in some instances have been considered as contributory or symptomatic factors of resistance. Differences between insecticde resistance and susceptible strains with respect to fecundity, size, longivity, colouration, ecological Characteristics, behavior and morphological changes have been reported in numerous cases in the laboratory. Study of the egg, larval pupal periods and their survival total developmental period, facundity and adult emergence revealed no significant change in the biology of the resistant strain from that of the susceptible strain.

----------, FRUITLY, BACILLUS THUSINGIENSIS, CONVENTIONAL.

61. **EL SEBAE (AH) and KOMEIL (AM).** Interaction of conventional Insecticides with Bacillus thuringlenes against the Mediterganean fruit fly ceralitis capilata (wied0. Annals of Entomologial Society of America. 1; 1990; 241-44.

The bacterial insecticide Bacillus thuringiensis subsp israllensis, serotype H-14 and the insecticides cyper melrin

dimethoa and methomyl were tested against large of ceratitis capitata combination of LC 10, LC30 and LC50 levels of the 3 insecticides with the LC 15 of B thuringiensis showed potentiation of toxicity of the lagal stage. The joint effect co as also found induce retardation and animates in the development of created larvae.

----------, GALL MIDGE, RICE STEM, RESISTANCE, IMPACT OF-.

62. **NAYAK (SK), PANDA (SKand BEHER (UK).** Impact of varietal Resistance and Insecticides on Rice stem borer and Gall Midge. Annals of Plant Protection Sciences. 8, 2; 2000; 140-144.

Eighteen treatments consisting of three variedties viz. Bhubana , or 48-1-44-17 and TN, five insecticides viz. Monocrotophos (0.05 kg.) endosulfan 90.5 kg), Carbaryl (1.0 kg), deltamethrin 90.12 kg) and neem oil (2.5 1/ha) along with an untreated check were evaluated for their performance against stem borer at the heading stage whereas, or 1-11-44-17 showed a high degree of resistance against 5 tm borer at the vegetative stage of the crop with a moderate level of resistance to gallmidge. Endosulfan gave excellent control of yellow stem borer whereas, fouler spray of the test molecules were found in effective against gall midge. Insecticides did not exhibit any adverse impact on the egg. Larval parasite of gall midge. A decrease in the level of varietal resistance against gall midge

due to insecticide spray was observed which was higher in TN, than on OR 148-1-44-17. The study demonstrated a great compatibility of resistant variety with chemical control in suppressing the pest damage. Rice is most important crop grown in Orissa.

----------, GENETIC, ENZYMATIC, INJURIOUS E. BENEFICIAL INSECTS.

63. **ROSLAVTSEVA (SA).** Resistance of injurious and beneficial insects to insecticides. Journal of Agricultural Entomology. 15, 8; 1992; 146-48.

This articles deals with the different groups of insect pests and beneficial insects are reviewed from the point of view of available up-to-date information on pesticide resistance and its investigation in different countries. Data are included on the species and the insecticides involved, development and levels of resistance, cross-resistance, genetic, enzymatic and other mechanisms, conditions of reversion to susceptibility, the use of synergists to reduce resistance and the monitoring of resistance.

----------, GRAM POD BORER, GRAM DIFFERENTIAL, SUSCEPTIBILITY.

64. **MANOHARAN (T) and UTHAMASAMY (S).** Differential susceptibility of field populations of gram podborer to insecticides in Tamil Nadu. Indian Journal of Agricultural Sciences. 64, 2; 1994; 126-31.

Differences in LD50s of 4 insecticides (endosulfan, phosalonal, fenvalerate and deltamethrin) were observed in field populations of Helicoverpa armigera from 3 areas in Tamil Nadu, India, in which upland cotton 9Grosspium hirsutum) and gram [Chickpea] are grown. The differential susceptibility of these populations may be attributed to frequent application of insecticides in some areas, leading to the development of resistane.

----------, GRAIN, WHEAT, SITOPHILUS ORYZAE, RESISTANCE TO SITOPHILUS ORYZAE IN WHEAT.

65. **RAM SINGH and VIJAY SINGH.** Resistance to sitophilus oryzae in wheat and Associated grain Characteristics. Bulletin of Entomological Research. 58,3; 1998; 79-89.

Wide variability in wheat germplasm has been found for resistance to several storage pests, especially rice weevil, sitophilus oryzae (L) as evident from the reviews on storage pest resistance. The studies undertaken so far on factors conferring rice went resistance have not been conclusive although several grain characters like hell, pericarp, hardness, size, protein fotty acid and crude fibre contents have been evaluated in some cass, as cited in the above referred reviews. Evaluation of 64 wheat varieties for resistance to rice weevil, using number choice progeny tests, srevealed considerable variability. Most resistant varieties were Raj 911, Kalyan Sona A.9.30-1 and PV 18, while HW 517, Shailaja, DL 20-9 and HD

2307 were most susceptible. Susceptibility to rice weevil was found to be correlated positively with grain size and negatively with harness, crude fibre and protein contents of the grains, while oil content did not reveal any correlation.

----------, ----------, ----------, **TROGODERMA GRANARIUM, TROGODERMA, RESISTANCE.**

66. **CHUNNI RAM and VIJAY SINGH.** Resistnac to Trogoderma Granarium in wheat and Associated grain Characteristics. Indian Journal of Agriculture of Sciences. 58, 1; 1996; 66-73.

Grain resistance to khopra beetle in 64 what varieties was evaluated through no-choice progexy tests and considerable varietal variation were evident. Most resistant varieties were C273, PV 18, Bijaga Red WH 291, Up 301, HD 2278 and Kalyan Sona while most susceptible response was evident in K8020 closely followed by HW 741, HD 2307, HD 2189, UP215 Hira Lok 1 and Janak. Khapra beetle susceptibility exhibited significant and negative correlations with grain hardness and crude fibre content but grains size, protein content and oil content did not show any significant correlation with the susceptibility. However, no effort has been made to identify grain characteristic conferring resistance to this pest and the few studies conducted on the aspect have not yielded definite correlation's.

----------, **GRAMPOD BORER, BETA-CYFLUTHRIN, CYFLTHRIN, PERSISTANCE AND BIOEFFICACY.**

67. **DIKSHIT (AK) and SINGH (SP).** Persistence and Bioefficacy of Beta-cuffluthrin Against Gram pod Borer, Environmental Entomology, 62, 3; 2000; 287-30.

To study the persistence and bioefficacy field experiments were carried out of beth-cyfluthrin against gram pod borer. Betacyfluthrin @ 18.75 and 37.50 g aiha (Bulldock 025 SC) was sprayed at the flowering stage flowering followed by second spray after 15 days. Residues on pods (whole) were at safe level after 10 days from recommended dose. Residues were not detectable in matured grains, straw and soil collected at harvest. The insecticide was found effective against H. armigera. Therefore, the schedule can be considered safe from toxic residues point third of the total area and 40 percent production under pulses.

----------, **GRAM POD BORER, CHICKPEA, LOCATION OF-..**

68. **WALTERS (FA), SINGH (B) and YADAV (RP).** Location of sources of resistance amongst chickpea, genotypes against gram pod borer, under normal sown conditions by using new parameters. Bulletin of Entomological Research. 17, 3; 1993; 173-80.

Seventy desi chickpea, genotypes were evaluated by using an open field screening technique under natural infatuation. The parameters used for evaluating these genotype were relative pest pressure index, relative, intensity of change index and relative pest pressure index, relative intensity of change index and relative productivity index. None of the genotypes could exhibit complete resistance to Heliothis armigera Hub. Or could evade the pest infesation. Considering all the three parameters, DHG. 84-11, P240, BG76 and DHG88-20, proved either less susceptible or more pest tolerant where as GNG 752, GCP89, G211 and KBG2 were highly susceptible in comparison to respective, P256, BR77, C235 and C243, belonging to phonologically four different groups of chickpea genotypes.

----------, **GRASS PEA, MILDEW, FUNGICIDE, EFFICACY.**

69. **MALANI (SS), KHARE (N), LAKPALE (N) and RAJIV KUMAR.** Efficacy of some fungicides against poiodery mildew of Grass Pea. Indian Journal of Plant Protection. 6,2; 1998; 131-5.

In an in vitro evaluation of eight fungicides for management of Erysiphe pisi, powdery mildew of grass pea, coilaf and calixin were found to inhibit germination of Conidia completely followed by Bavistin, karathae and Tposin M. under in vivo condition calxin, conteaf and Bavistin were found effective in reducging the disease severity, but on the basis of cost: benefit

ratio, Bavistin gave highest additional net return followed by contaf and calix. Grasspea lathyrus sativus L is an important pulse cropin the eastern part of Madhya Pradesh. It is extensively grown after Paddy with minimum management practices. Besides ODAP (B-N oxalyl L, α-β Deaminopropionic acid content, the seeds than other pulses. Powdery mildew caused by Erysipheplsisyed in flicto heavy losses in yield upto 30-40%. Therefore, an attempt was made to study the effectiveness of different fungicides under in vitro and in vivo-conditions for management of the disease.

----------, GREEN GRAM, MILDEW, OPTIMAL FUNGICIDAL STRAY.

70. **SAXENA (DR) and SAXENA (M).** Optimal Fungicidal spray to control powdery mildew of Rainyseason Green Gram. Annals of Plant Protection Sciences. 7,1; 1999; 59-62.

Field trials for the control of poiodery mildew of green grain with various fungicidal sprays revealed carbendazim (a) 0.05 and 0.1% were equally effective in all three years of trial. Maximum yield was obtained in carbendazim 0.05% followed by its lower concentration 0.05%. However, carbendazim at 0.05% gave maximum net profit followed by its 0.1%. Therefore, single spray with carbendazin was found to be economical infontrolling pocodery mildew of green gram during rainy season. Powdery mildew, caused by Erysiphe Polygoni D.C., is an important disease of green gram (Viga

radiata 2) wilczek in southern and central states between 12 to 24^0N. In present investigation, efforts have been made to find out most effective and economical fungicidal rainy season green gram that can control the disease in single spray because the conventional non systematic fungicides reported earlier.

----------, GREEN GRAM, THRIPS, EFFECTIVE CONTROL.

71. **GUPTA (PK) and SINGH (J).** Effective control of Thrips by soil application of Granular Insecticides in Greengram. Indian Journal of Entomology. 54,4; 1992; 465-70.

The granular formulations of some insecticides have recently become quiet popular for sap sucking pests like Jassids trhips and bugs (Lal and Pradhan, 1977). Recent thinking on integrated pest management also favours the use of systematic granular formulations for the control of folier pests to keep the aerial portions of the plants free from contamination and residues of insecticides thus allowing the parasites and predatons to remain active. Taking these in view some granular insecticides were tested against thrip (Megalurothrips distalis Karny) in green gram (Vigna radiate hinn.) wilczek).

----------, GREEN PEACHAPHID, MUMMIES, APHELINUS ASYCHIS, DEVELOPMENT OF-.

72. **RO (Tae Ho), LONG (GE) and RO (TH).** Development of Aphelinus ascyhis (Hymenoptera: "Aphelinidal) and its

susceptibility to insecticides applied to Mummies of its host the green peach aphid. Annals of Entomological Society of America.

The suitability of the green peach aphid, muzus persical, as a hast for Aphelinus aschis, was determined A. aschis imported from france was adopted to M. Persical reared in Potatoes in the Laboratory. Females deposited about 95 eggs over 21 days in various stages of aphid including alates. Total larval developmental time (14.5 days) was shorter than the longevity of adult females. The mean daily emergence (61%) and comulative emergence (73.3%) from Mummies treated with pirimiearb were significantly higher then those from Mummies treated with Methamidophos (4.1) and 49.2% respectively) and disulfoton (0.6 and 6.7% respectively). The high fecundily and emergence and reduced susceptibility of A. asychis to mimicarh, suggest it is a polential biological control agent in integrated pest management programs for green peach aphid.

----------, GROUNDNUT, SUCKING PESTS, EFFECT OF-.

73. **SABOO (KC) and PURI (SN)**. Effect of Insecticides on incidence of sucking pests and yield of groundnut. Indian Journal of Agricultural Sciences. 40,3; 1985; 311-15.

This article describes about the Groundnut that the stage of its growth is subjected an attack by various insect pests. The

plant suffers from the ravages of insect and production both in terms of quality and quantity. Chlorinated insecticides like DDT and six other insecticides was studied but these were unable to control the resistance of hopper.

----------, GUANDONG, RICE LEAF FOLDER, RESISTANCE OF THE RICE LEAF.

74. **XIAO (ZY), HUANG (ZX) and HUANG (DP).** Resistance of the rice leaf folder to insecticides in Guangdong. Karean Journal of Entomology. 53,3;1994;35-37.

Fifth-instar larvae of the pyralid Cnaphalocrocis medinalis were used to study the reaction to contact poisoning by 4 insecticides. Spot tests indicated that Tamaron was the most toxic, followed by Padam, acephate and shachongshang. In 1 or 2 prefecturs, rice showed low resistance to the pyralid and the relative toxicity index of the insecticides to the pest was 13.89. In other prefectures in Guangdong development of insecticide resistance in the pyralid was slow with relative toxicity induces less than 4.06.

----------, HARMONE ANALOG, METHOPRENE-TOLERANT, DROSOPHILA, COMPETITIVE ABILITY.

75. **MINKOFF (C) AND WILSON (W).** Competitive ability and fitness components of the methoprene-tolerant Drosophila mutant resistant to juvenile hormone analog insecticides.

Biotechnology and genetic engineering Review. 4,2; 1997; 63-7.

The methoprene-tolerant mutation of Drosophila melanogaster resutls in a high resistance to the insecticide methoprene. Pest species controlled by methoprene may threfore have the potential to envolve resistance via a similar mutation. Fitness components of flies homozygous for each of 5 met alleles were compared with those of wild-type strains. In the absence of methoprene, met flies were outcompete by a wild-type strain both in a multigeneration population cage and in single-generation competition experiment small but significant differences were found between the polled met alleles and wild type for pupal development time. Although met flies were found to have reduced fitness by these measures, the phenotype was not as badly affected as might be expected from the disruption of Juvenile regulation seen in met flies.

----------, **HELICOVERPA ARMIGERA, CHEMICALS, RESISTANCE.**

76. **NARESH SINGH, SEKHAR, VENGOPAL (N) AND VENKATAIAH (M).** Estimation of Insecticide Resistance in American Bollworm Helicoverpa Amrigera under varied conditions. Indian Journal of Agricultural Sciences. 58, 2; 1996; 155-60.

The phenomenon of resistance to insecticide in Helicoverpa that surfaced under different agro Eco-system is the major negative side of chemical control strategy. Influence of larval age and weight on insecticide resistance in Helicaverpa armigera was guantified in continuation to the monitoring of this phenomenon in various populations of Helicoverpa in Andhra Pradesh. The LC50 values of the commonly used insecticides were found contrasting high with reference to Guntur populations when compared to non cotton growing areas of the state. The profound impact of larval age body weight on the efficacy of insecticides was also quantified to reason the failure of chemicals under broad overlapping situations.

----------, HELICOVERPA ARMIGERA, DIPAROPISIS WATERSI, CHANGES

77. **REYNOLDS (D) and ARMES (N).** Changes in the sensitivity of Diparopsis watersi and Helicoverpa armigera to chemical insecticides. Natural Enemies of Insects. 48, 4; 1993; 83-85.

The toxicity of insecticides that had been used against Helicoverpa armigera and diparopsis watersi on cotton in chad since 1992 was monitored in the laboratory. No resistance to pyrethroids was detected in the noctuids, but developments of tolerance could be in progress. There was a return in sensitivity to organochlorine insecticides.

----------, **HELICOVERPA ARMIGERA, INSECTICIDE, COTTON INFLUENCE OF-.**

78. **NAGESH (M), RAO (N), RAJA SEKHAR (P) and VENKATAIAN (M).** Influence of certain factors on Insecticet Resistance in American Bollworm Helicoverspa.. Armigera. Bulletin of Entomology. 58, 2; 1993; 42-7.

Helicoverpa armigera, a regular pest of cotton pulses, oilseeds, millets and vegetable crops under Andhra Pradesh situation, attract the attention of many because of newly acquired phenomenon of insecticide resistance as was experienced in Australia only. Influence of certain Ecofactor like host plant season and source of larvae were studied on the insecticide resistance of Helicoverpa armigera. The resistance levels were found to be varying from crop to crop as well as within a seasons reflecting the role of Ecofactors in determining the resistance besides the selection pressure created by insecticides. The increase in resistance towards the fag end of growing season indicated the selection of resistance individuals with heavy age of insecticides during early stage risking availability of susceptible refuge to dilute the build up of resistant populations.

----------, **HELIOTHIS ARMIG, CROP, MONITORING OF INSECTICIDE.**

79. **TRIPATHY (MK) and SINGH (HN).** Monitoring of insecticide resistance in Heliothis armigera from areas receiving very low insecticidal applications at Varanani and U.P. Journal of Entomologial Research. 23, 4; 1999; 281-91.

This article deals with the insecticidal resistance in Heliothis armigera which was undertaken in the adjacent areas of Varanasi over all cropping seasons. The study revealed that the mean percent survival of third fourth instar larvae to cypermethrin was 77.77 during 1995-96 and 80.39% in 1996-97. At cypermethrin 1.0 larvae, the percentage survival was 45.68 and 55.45% during 1995-96 and 1996-97. Use of piperonyl butoxide never suppressed the pyrethroid resistance in none of the season collections indicating metabolic resistance to be the one among several mechanisms for metabolic resistance development in this species at Varanasi. Further, resistance to endosulfan levels and quinalphos remained at low to moderate and moderate to high levels. This suggested that selection pressure by insecticides is not the sale determing factor for degree of resistance of H. armigera as either very less.

----------, **HELIOTHIS ARMIGERA, FRUIT BORER, TOMATO, VARIETAL RESISTANCE.**

80. **MISHRA (PN), SINGH (MP) and NAUTIYAL (MC).** Varietal Resistance in Tomato Against fruit Borer, Heliothis Armigera. Journal of Insect Behaviour. 34, 6; 1992; 63-8.

Tomato fruit borer, Heliothis armigera. Hub is one of the serious pests attacking tomato Point resistance offer good method of control auoiding all the hazards associated with the chemical control measures. A field trial for the scdreening of 35 tomato varieties for resistance to fruit borer. Heliothis armigera was carried out at the Hill campus. Fruit damage in different varieties varied considerably variety Angurlata was graded as highly resistant recording lowest fruit damage and required maximum days for first fruit set. A highly significant negative correlation between the earliness and percent fruit damage was observed with most of the varieties except three varieties where bigger fruit size might be for higher susceptibility to fruit borer.

----------, HELIOTHIS ARMIGERA, RESISTANCE, HUBNER, DEVELOPMENT, ANDHRA PRADESH.

81. **REDDY (GR), CHITRA, RAO (PK) and GUPTA (RP).** Development of resistance to insecticides in diffferent populations of Heliothis armigera Hubner in Andhra Pradesh. Annals Review of Entomology. 53, 3; 1991; 393-95.

Larvae of Heliothis armigera were collected from 3 cotton - growing districts in Andhra Pradesh (Guntur, Rangardedy and Chittor) reared in the laboratory for 2 generations and assayed for resistance to monocrotophos, endosulfan, carbaryl and fenavalerate. Resistance factors were highest in strain collected from the Guntur district.

----------, **HELIOTHIS VIRESCENS, ENZYMES.**

82. **MECAFFERY (AR), WALKER (CH), CLARKE (SE) and LEE (KS).** Enzymes and resistance to insecticide in Heliothis vereseens. Biochemical Scoiety Transactions. 19,3; 1991; 762-64.

This article deals with the enzymes and resistance to insecticides aimed at the development of diagnostic assays for use in pyrethroid insecticide resistance monitoring programmes, these mechanism were studied in a rangke of laboratory and field strains of the noctuid Heliothis virescens, with special attention to the effects of cypermethrin. It was shown that the metabolifc resistane of strain PEG87 is a consequence of itlsk elevated mono-oxygenase system in particular the higher specific content of cytochromek P-450. In the case of trans-cypermethrin, there is also evidence that the esterase of the cytosolic fraction may contribute to resistance, as it is more active in the PEG87 than in the BRC insects.

----------, **HETROADERA CAJANI, CYST NEMATODE, PIGEONPEA, SCREENING OF PIGEON PEA VARIETIES.**

83. **SIDDIQUI (MR), GUPTA (P) and HYDER ALI.** Screening of Pigeon pea varieties for Resistance to the Pigeonpea Cyst Nematode Hetrodera Cajani. Annals of Plant Protection Sciences. 6,2; 1998; 193-2000.

Pigeonpea (Cajanus cajan Mill sp.) is a major pulse crop of India providing for much of the protein supplement to her largely vegetarian population pigeonpea cyst nematode, Heterodera Cajani is distributed in all Pigeonpea growing areas of the country. This nematode species causes significant loss of crop yields. Difficult in managing plant parasitic nematodes by chemical and other methods has necessitate the search for crop varieties resistant/tolerant to nematode attack. For sustainable production of pulse crops. The initial identification of the source of resistance is the essential starting point in breeding for resistance against nematodes. Seeds of 104 varieties of Pigeonpea obtained from Indian Institute of Pulses Research, Kanpur were sown in 15 cm diameter carthen pots conlaining approximately 500 g soil. Fifteen days after germination the seedling were inoculated with H. Cajani @ 2 juvenile /g soil. The juvenile suspension, used for inoculation was obtained by crushing cysts collected from glass house culture of H. Cajini maintained in Cowpea.

----------, HORN FLY, CHEMICALS, CONTINIOUS ATTRACTING AND MIXED INSECTICIDES.

84. **MEKENZIE (CL), BYFORD (RL).** Continuous, alternating and mixed insecticides affect development of resistance in the horn fly. Annual Review of Entomology. 85, 5; 1994; 65-70.

Insecticideselection was applied as loro-volume sprays on steers infested with flies housed in environmentally controlled

rooms. During the study period, fly populations developed an apparent resistance to all insecticide treatment regimens. Selection with insecticides mistures and rotations resulted in the delay of any apparent resistance development for an additional 1-7 generations. The magnitude of this resistance ranged from 1470-fold for the single continuous use of permethrin to <3 fold for the ivermectin in the permethrin ivermectin rotation. Compared with single continuous insecticide selections, the onset and degree of resistance development was significantly reduced by alternating and mixing insecticides.

----------, HOST PLANTS, SPODOPTERA LITUTA, SUSCEPTIBILITY.

85. **SUDHAKAR (DSL), CHITRA (KC) and RAO (PK).** Susceptibility of spodoptera litura fabricius to cestaui uscictucdes and its larval development in relations to host plants. Journal of Entorlogical society of Brlish Columbia. 55,3; 1993; 291-96.

The effect of 3 food plants on the susceptibility of larvaeof spodoptera litura to 7 insecticides cost studied larval were reared on castor (Ricinus communis), green gram [Vigna radiata] and groundnuts and 4th instar larvae were exposed to afil of cypermethrin deltamethrin, fenvalerate, fluvalirate, carbaryl, monocrotophos or quinalphos. Larval development was fastes on R. communis with the larval period lasting 15.62 days. The order of suitability for development was R. communis

V. radiata and groundnut. Larvae were most susceptible to insecticides on groundnut, followed by V. radiata and R. communis. The relative loxicity of the fluvalinate > quinalphos > monocrotophus > carboryl.

----------, HUBLAE PUREA, TEAK DEFOLIATOR, RELATIVE TOXICITY.

86. **ROCHOUDHURY (N) and JOSHI (KC).** Relative Toxicity of certain Insecticides Against the larvae of teak Defoliaton Hublaca Purea. Indian Journal of Applied Entomology. 58, 3, 1996; 253-55.

Teak is undeoubted by one of the most valuable, hard wood timber species found in the tropical deciduous forests of India. Of about 280 and odd species of insects sreported so far on teak, about 139, insects are defoliators (Mathur, 1960; Mathur and Singh 1960) of these teak defoliton, Hyblaca purea creamer (Hepidopetera; Hyblacidae), is a major pest of teak the larvae of which causing larvae scale defilation regularly in nursery and plantations in all teak growing areas. Relative Toxicity of two synthetic pyrethroids two organism phosphates and an organochlorine insecticide was worked out against the larvae of teak defelioator, Hyblaca puera. Cramer Hlepidoptera: Hyblacidae) on the orders of toxicity was deltamethrin > alphamethrin > malathion > moncrotophos > endosulfan.

----------, **INSECT PEST, SOIL APPLIED, ACCELERATION DEGRADATED.**

87. **DZANTOR (EK) and FELSOT (AS).** Accelerated degradation of soil-applied insecticides implications for insect pest control. Journal of Environmental Science and Health. 24, 6; 1998; 983-91.

There is increasing evidence that repeated use of some insecticides to the same soil can lead to the devwelopment of highly active microbial populations which are able to degrade the insecticides rapidly. Carbomate and organophosphorus insecticides correlated with their field performance against soil inhabiting insects such as Delia radicum and Psila rosal showed that the efficacy of some insecticides was reduced by a single pre treatment with a commercially recommended dose. Degradation of aldicarb was enhanced more by pre treatment with carbofuran than by aldicarb. Studies with phorate and mephosfolan showed that accelerated loss was influenced by soil pH and by dose leve.

----------, **LEAF HAPPERS, RICE GREEN, ZINC, INFLUENCE OF-.**

88. **PADHEE (AK) and MISHRA (DS).** Influence of Zinc application on the Incidence of Rice Green Leaf Hoppers. Indian Journal of Plant Protection. 57, 1; 1995; 10-4.

Leaf and plant hoppers constitute one of the major groups of most important pests of rice. Among the hopper complex of rice the green leafhoppers Nephotlix virscens and Nephotettix nigropictus (stal) come next to the brown planthoppers, Nitparvata lugens stal in terms of Economic importance. The leafhoppers suck sap from the leaves resulting in reduction of plant vigour followed by drying of crop. The application of fertilizer/nutrint elements among the major impub of crop management influences the best density in rice crop. Among the micro nutrients rice crop is very sensitive to low levels of available Zinc in soil.

----------, LEAF SUGARY, APHID, DEPHACID, SORGHUM, BIO-CHEMICAL, BIO-PHYSICAL.

89. **MOTE (UN) and SHAHANE (AK).** Biophysical and Bio-chemcial Characters of sorghum varieties contributing Resistance to Dephacid, Aphid and leaf sugary Exudations. Journal of Insect Behaviour. 56,2; 1994; 113-22.

Seeds of twelve sarghum varieties (Resistant: 13-1840, 8TP-28, IC/CI-7, ICSV-148, IC5C TV-9; moderately resistant : 15-453, 15-1063, ICSCTV-6, SPV-504; susceptible: 15-2217 and M-35-1 to delphacid, aphid and leaf surgary exexudation) were soon during season of 1987 both in field and pat conditions. Delphacid, peregrinus maidis Ashmead aphid, Melanophis sacchari Zehanter and leaf surgary exudation are the major problems in sabi sarghun in Semi arid track of India.

Seventy eight sorghum varities were screened for their reaction to these two insect pests and a malady during rabi season. Twelve varieties were selecte selected on the basis of their resistance to decphacid, aphid and LSE and their morphological chemical characters were studied.

----------, LIPAHIS CRYSIMI, MUSTARD, ALLIED GENOTYPES, BASSICA.

90. **VEKARIA (MV) and PATEL (GM).** Screening of promising Bassica and allied genotypes for resistnace against mustard aphid, lipaplis crysimi. Indian journal of Agricultural Sciences. 62,1; 2000; 37-42.

The mustard aphid, lipaphis crysimi kalten back is a serious pest of cruciferous crops. The availability of resistant sources has been greatly emphasised all over the world as one of the most appropriate tool of the intrated pest management as it is easy to adopt. Economical and safer than chemical pesticides. The importance of resistance can be well understood by looking into the fact that the presence of small level of pest resistance in a variety helps in the reducing more than one third concentration of insecticidal spray fluid to achieve the equivalent kill of the pest as one susptible variety. Relative resistance of forty promising Brassica and allied genotypes against mustard aphid was studied in the field condition C.P. College of Agriculture during rabi in 1993-94. None of the

genotype tested was found immune however, five genotypes were found resistant against mustard aphid.

----------, LIPAHIS ERYSIMI, MUSTARD, APHID PERIODIC CHECKING.

91. **DHINGRA (S).** Periodic checking to detect development of resistance in mustard aphid. Journal of Applied Entomology. 15, 2; 1991; 88-92.

The relative toxicity of 11 insecticides to apterous adults of lipaphis erysimi collected in the field in Delhi. On the basis of LC50s oxydemetonmethyle, chlorpyrifos, dimethoate and pyrethrum were 25.61, 11.92, 7.56 and 1.37 times as toxic as lindane and the other 5 compounds were less toxic than lindane. A comparison of tonicities of commonly used and recommended insecticides determined periodically over the past 23 years, showed some changes, but the tonicities for recommended insecticides were still well within the range normally used against the aphid.

----------, LIPAPHIS ERYSIMI KALE, MUSTARD, DEVELOPMENT, CONCENTRATIONS EFFECT OF-.

92. **TRIPATHI and SACHIN (GC).** Effect of concentrations of insecticids on the growth and development of mustard aphid, Lipaphis crysimi Kalt. Journal of Research - Angrau. 52, 1; 1990; 63-8.

The effect of various sublethal concentration of the pyrethroids decamethrin, cypermethrin and fevivalerate on growth, development and reproductive potential of lipophis crysimi on Indian mustard are described from laboratory experiments. The finding indicated that these compounds may cause resurgence like situations in the the field when applied at very low concentration.

----------, MAIZE, ANTHERIGONA SPP., BIOCHEMICAL PLANT FACTORS.

93. **RAO (KR) and PANWAR (VPS).** Biochemcial Plant Factors affecting Resistance to Intherigona spp. in Maize. Indian Journal of Plant Protection. 9,1; 2001; 37-42.

The Maize resistant, moderately resistant and highly susceptible cultivars to shoot fly species, (Antherigona soccata Rondani and A. naqii steyskal) were taken to study the role of biochemical plant factors imparting resistance to shoot flies at various stages of crop growth. None of the biochemical plant factor had influenced the egg laid by the shoot flies in the field. Significant positive correlation of nitrogen and crude protein content at 5-10 and 15DAE and Carotenoid content in 10 DAE was observed with dead heart percentages caused by Intherigona spp. It showed that the resistant varieties had low carotenoid nitrogen and crude protein contents as compared to susceptible maize cultivator. The shootfly species, cause dead heart formation in seedling stage fo maize leading to total loss

of the crop and posing a serious threat to maize cultivation during spring season in and around Delhi.

----------, **MAIZE, PYRILLA PERPUSILLA, RESIDUAL TOXICITY, PERSISTANCE.**

94. **SINGH (MR), MRAWAHA (KK). and TRIPATHI (GM).** Persistence of Residual Toxicity of some insecticides against pyrilla perpasilla Infesting Maize Journal of Insect Behaviour. 50, 6; 1993; 43-7.

Pyrillaperparilla wek is one of the serious sucking pests of sugar cane throughout the country besides sugarcane. Residual toxicity of Phosalone chlorophyriphos, phenthoate EC and phenthole dust against adults of P. perpurilla was studied by exposing adult hoppers for twenty four hors to the maze leaves treated with 0.025, 0.05, 0.1 and phenthorte dust 2.0 percent. On the basis of LT50 values the order of relative efficacy was phenthoate dust 2.0 followed by chlorpyriphos 0.1 percent. Phenthoate 0.1 percent, phosalone 0.1 percent, chlorpyriphos 0.05 percent, phosalone. The respective period for which toxicity of aforesaid concentration persisted was 20, 15, 14, 13, 12, 11, 9, 7, 8 days respectively chlorphyripas proved to be more toxic than phenthoate EC and phosalone responded low residual against the pest.

----------, **MAIZE STEM BORER, RELATIVE TOXICITY AND PERSISTANCE OF PLANTS.**

95. **BHATNAGAR (A) and SHARMA (VK).** Relative Toxicity and Persistance of Plant Products Against Maize stem borer on Maize. Indian Journal of Plant Protection. 7,2; 1999; 144-49.

The relative toxicity of semisoled, crude extracts of nine plants species and persistence toxicity of clean plants extract were evaluated as foliar application on Maize against Chilo partellus under laboratory and glass house conditions, respectively. Methanolic fraction of Boigainvillea spectabilis flowers was the most toxic amongst the plant extracts and recorded the lowest LC50 values (0.318) followed by distillelkd water leaves extract of Nerium induces. The Maize stem borer Chilo partellus (swinhoe) cause extensive damage to Maize. Systematic insecticides are commonly used for controlling stem borer, Larvae. The use of plant productes as an alternative to synthetic organic pesticides for the control of insects pests have promise since large number of indiginous plants, are rich sources of potent chemicals for pests control either by toxic action or due to the presence of secondary metabolities which act as repellent, attractants antijeedants.

----------, MELODOGYNE INCOGNITA, ROOT-KNOT NEMATODE, COTTON, CULTIVARS, EVALUATION OF-.

96. **PANKAJ, SIROH (A) and GANGULY (AK).** Evaluation of cultivars/lines of cotton for resistance against Root-knot nematode, Meloidogyne incognita. Indian Journal of Plant Protection.4,1; 1996; 93-4.

Cotton (Gossypium spp.) is an important fibre crop in India, covering an area of 7.4 million hectare and with an annual production of about 9.8 million bales. The root-knot nematode, meloidogyne sp. Problem on cotton in India was first reported by Lu8thura and Vasudeva 91939) from Punjab, followed by Thapar (1940) who reported the occurrence of root-knot and the reniform nematode, Rotylenhulus reniforms on cotton. Therefore, nineteen cultivators/lines of cotton (Gossypium spp.) procured from IARI, New Delhi and Hav, Hisar was screened against root-knot nematode, M. incognita Race-1 under green house conditions during the months of May-June, 1995. Two seeds were sown in the 10 cm diam. The observation on number of eggmasses, member of galls and gall index was recorded 30 days after inoculation. The plants were catagorized as resistant, moderately resistant, susceptible and highly susceptible as per the root-knot index on a 1-5 scale. Three moderately resistant, eight lines were susceptible and six lines were found to be highly susceptible.

----------, MELODOGYNE INCOGNITA, ROOT KNOW NEMATODE, TOMATO, JPERSISTANCE.

97. **GANGULY (AK), SREEDHAR (M) and SWAIN (SC).** Characterization of Partially Purified Acid Phosphatase from susceptible and Resistant Cultivars of Tomato against Root knot Nematode Meloidogyne incognita. Indian Journal of Plant Protection. 8,1;2000;47-52.

Investigation was carried out to characterize acid Phosphatase from uninoculated and inoculated tomato cultivators Pusa Ruby (Susceptible) and Pusa (Nemamukt Resistant) against melodogyne incognita. The enzyme was partially purified using sephadex 6-25. Highly Purified enzyme with high specific activity was obtained from all the four samples. On characterization it was observed that the pH optima for the enzyme was between 3.5 and 4.5 temp optima between 3.5 and 4.5 temp otima between 30^0C to 40^0C. The enzyme has wide substrate specificity favouring both synthetic and natural substrates, inhibited by sodium phosphate, molybolic acid and copper sulphate. Thee was no difference in Km value between resistance and susceptible cultivator. But vmax was highest in the resistant inoculated cultivator. The importance of acid phosphatase in resistant expression have been discussed earlier by various workers in tomato lycopersicon esculentum against root know nematode.

----------, **MICROCEROTERMES BEESONI SYNDER (TERMITE), BAMBOOS, NATURAL RESISTANCE.**

98. **MISHRA (SC) and RANA (SS).** Natural Resistance of bamboos to termite Microcerotoermes beesoni synder. Journal of Entomological Research. 16,4; 1992; 311-18.

This articles deals with the Natural Resistance of bamboos to termite, certain wood species are known to posses inherent quality of natural resistance against termite damage. Thirteen species of bamboos were evaluated in the laboratory for their natural resistance to termite, Microceraterms beesoni soyder, a common subterranean wood destroying species. It was observed that Bambusa nutants, Dendrocalamus strictus, B. balcooa and D. giganteus were relatively more resistant as compared to other species like, D. calostachys, B. vulgaris var. wamin, oxytenanthera albaciliatea, D. membranaceus, B. valugaris, Ochlandra travancorica, B. tulda, D. longispathus and D. lamiltonii and are comparable with some of the durable timberk species like shorea robusta, Anogessus latifolia and Garuga pinnata.

----------, MONOCROTOPHOS, SPODOPTERA LITURA, DYNAMICS.

99. **RAMEGOWDA (GK), BASAVANAGOUD (K), PATIL (RK) and KULKARNI (KA).** resistnace to insecticides and its dynamics to monocrotophos in spodoptera liture (F). Journal of Entomological Research. 25,3; 2001; 229-33.

The tobaccco caterpillar, spodoptera litura (F) is one of the major defliator pests of groundnut growing states of India. The resistance to cypermethrin, quinalphos, monocrotophos and endosulfan in spodopter liture collected from groundnut field. The resistance levels in comparison to a reference strain were of the order cypermethrin > quinalphos > monocrotophos > endosulfan. Studies mode to know the dynamics of monocrotophos resistance revealed that it was almost static from August 1998 at Dharwad to February 1999 (13.06 to 14.53 folds), excepting a like during October 1998 from March ownwards resistance started increasing and reached peak (37.16 folds) during April 1999 when it was last studied.

----------, MONOLEPTA LONGITARSUS, CASHEW LEAF, NEEM, EFFICACY.

100. **MOHAPATRA (LN).** Efficacy of some synthetic Insecticides and neem products Against Cashew leaf Bettle, Monolepta Longitarsus. Indian journal of Applied Entomology. 63,1; 2001; 11-3.

Chashew, Anacardum accidental L. is one of the important lorticultural crops grown extensively in west and East coast of India. Among the insect pests attacking cashew. Leaf, beetle, Monolepta Longitarsus Jac is a pest of minor significance efficacy of seven synthetic insecticides and two neem products against cashw leaf bettle, monolepta longitarsus Jac was evaluated during 1996, and 1997. It was observed that two

rounds of spraying either with triazophos (0.05%) or monocrotophos (0.05%) at 15 days interval was found effective in reducing the bettle damage. This was taken against agroclimate conditions of coastal Orissa.

----------, **MONITORING PROGRAMMES, RESISTANCE, PYRETHROID, DIAGNOSTIC ASSAYS, DEVELOPMENT OF-.**

101. **DRANTOR (EK) and FELSOT (AS).** Development of Diagnostic assays for use in pyrethroid insecticides resistance monitoring programmes. The Canadian Entomologist. 19,3; 1993; 762-65.

This articles describes about the development of diagnostes assays for use in pyrethroid insecticides resistance. It was shown that the metabolic resistance of stran PEG 87 is a consequence of its elevated mono-oxygenase system in particular the ligher specific content of cytochrome P-450. In the case of trans-cypermethren, there is also evidence that the esterase of the cytasolic fraction may contribute to resistance as it is more active in the PEG-87 than in the BRC insects.

----------, **MOSQUITOES, SEED COAT, NBEEM; TOXICITY OF-.**

102. **SAGAR (SK) and SEHGAL (SS).** Toxicity of Neem seed coat Extract Against Mosquitoes. Journal of Agricultural Entomology, 59,2; 1997; 215-23.

Acetonc extract of neem seed coat (ACNSC) was used against Aedes aegypti and culx quinque jasciatus to assess its toxicity, growth regulating capacity and inpact on hatchability when A. aegypti larvae in their first instar were exposed to a low concentration of ACNSC, no mortality was observed. At high concentrations, the larval mortality occurred in a dose-dependent manner. A concentration of 40 ppm caused 100% mortality of the first instar larvae while in C-quinque fasciatus mortality of same magnitude was caused by a dose of 20 ppm. Even at lower conen pupal mortality was observed in C. quinquefascitus but no pupal casualty occurred in A. oegypti insect growth effect of ACNSE were assessed in both the species but in A. oegypti. The effect was more pronounced Eggs of both the species treated with ACNSC had no adverse effect on hatching.

----------, MUSHROMS, ENDOSULFAN, DIFLUBENZURON, BENDIOCARB.

103. **GEELS (FP) and RUTJENS (AJ).** Bendiocarb and difluberzuon as substitute insecticides for endosulfan in commerical Mushroom growing. Journal of Entomological Society of British Columbia. 120,2; 1992; 215-24.

Treating compost and casting soil with diflubenzuren and bendiocarb, each at a rate of 1 g.ai/m^2, resulted in comparable or improved compost and casting soil colonisation by Mushrooms over endosulfan treatments (applied at a rate of 1.5 a.l./m^2).

Alternating diflubenzuron/bendicorab treatments were preferable to the reverse treatments, which tended to diminish total yield of Mushrooms significantly by 1.4-3.9 Kg/m^2. The effectiveness of three were over cont. This assessment of tolerance in M. haterata emphasized the need for substitute insecticide with different modes of action, in addition to environmental reasons the authors conclude that chemical should be applied alternately within individual crops to avoid the development of resistant.

----------, MUSTARD APHID, TOXICITY, RESISTANCE, RELATIVE EFFICACY.

104. **HARDY (AR), WALKER (CH) and THOMPSON (HM).** Relative Efficacy and Resistance of Toxicity of Insecticides against Mustard Aphid. The Canadanian Entomologist. 63,2; 2000; 186-91.

The laboratory test on the relative toxicity of insecticides against Mustard aphid revealed that phosphamidon was ost toxic insecticides followed by dimethoate, lindane, thimeton and chlorpyriphos, phosphamidon remained most effective upto 14 days followed by dimethoate. On the basis of relative persistance toxicity the insecticides showed the order of efficacy as phosphamidon > dimethoate >Lindane > thiomethon > carbaryl > Malathion > Endosulfan > quinalphos. On the basis of PT values, dimethoate, lindane, thiometon, carbaryl, malathion, endosulfan and quinalphos were 0.88, 0.76, 0.67,

0.63, 0.59, 0.52 times less toxic than phosplamidon. Among the granules, disulfoton and phorate were found most toxic to the aphid upto 78 days after which the former maintained its toxicity for longer duration them the latter.

----------, MUSTARD, CHROMATOMYIA HORTICOLA, LEAFMINER, RELATIVE EFFICACY, WESTERN UTTER PRADESH.

105. **GOEL (RA) and SANJAY KUMAR.** Relative Efficacy of Insecticides against Leafniner, Chromatomyia Horticola, Infesting Mustard in Western Uttar Pradesh. Indian Journal of Applied Entomology. 54, 4; 1992; 411-14.

Larval of chromatomiya horticola indiscriminately on the internal tissues of the leaf resulting in great loss to the grower by damaging the mustard crop both at vegetable and flowering stage. Further more the infested plants are made nutritionally poor, interfering pholosynthesis and become unless as leafy vegetable to control this pest on mustard, for nothion thioneton phorate, carbofuran, aldicarb, disulfoton, phosphamidon, dimethoate and oxy-demeton methyl have been recommended. The Relative efficacy of some commonly used and new insecticides against larval and pupal of C. horticola was evaluated in the month of March, 1991, when the infertation was at its peak. Results of which are presented in this paper.

----------, **MUSTARD CROP, APHID POPULATION, EFFECT OF-.**

106. **SINGH (SV) and SINGH (YP)**. Effect of insecticides on aphid population, plant growth and yield of mustard crop. Journal of Applied Entomology. 36,8; 1991; 48-9.

In field trials in India, granular ardicarb, phorate, disulfoton and dimethoate each at 1.5 kg a.i./ha applied 40 days after sowing were compared with 3 foliar sprays each of thiometon, phosphamidon, dimethoate and methyldemeton at 0.3, kg a.i./ha nitrogen levels of 40 and 80 kg/ha for the control of lipahis crysimi on mustard. The effectiveness of the granular insecticides at 40 kg N was equal to that of the foliar sprays at 80 Kg N. The higher level of nitrogen was more conducive to the development of the crop and the pest. Application of granular insecticides 40 days after sowing at 40 Kg N is recommended for the control of the pest.

----------, **MUSTARD, LIPAHIS CRYSIMI KATT; IMPACT OF-.**

107. **MALIK (YP) and DEEN (BHAGWAN)**. Impact of Aphid (Lipaphis crysimi) Intensity on Plant Growth and Seed Characters of Indian Mustard. Indian Journal of Applied Entomology. 59,3; 1997;36-42.

Aphid, Lipahis crysimi kalt, causes enormous looses in yield in rapessed and mustard in different parts of the country.

The reduction in pest population may be conducive for enhancing the plant canopy which influences the variation in yield attributing characters. Thus the impact of varying aphid population was determined on the plant growth and seed characters on Indian Mustard. Negative correlation was found between aphid (Lipaphis crysimi Kalt) intensity and plant growth as well seed characters viz plant height, branch plant, siliqual plant, grains/siliqua test weight, seed size, seed yield oil content and oil yield in Indian Mustard (Brossica juncea). The seed characters were found to be significantly dependent upon the plant characters in increase in Aphid intensity was responsible for reduction of plant height branch/plant, siliqua/plant, grains/siliqua, test weight seed yield, oil content and oil yield.

--------, MUSTARD, LIPAPHIS ERYSIMI, ENDO SULFAN.

108. **SEEMA KUMARI and SINGH (IP).** Efficacy of Endosulfan against Lipaphis and Persistance of its Residues in Mustard. Journal of Insect Behaviour.. 59,2; 1997; 203-08.

The mustard aphid has been found as the key pest of mustard crop. The incidence of aphid starts at the vegetative phase of the crops but the major infestation occurs during the reproductive phase under the 73.3%. The infestation of aphid not only results in reduced yield of the seeds but also causes reduction in the oil content upto 66.87 percent. Bioefficacy and

persistance of endosulfan on mustard against lipaphis erysimi kalt was studied. All dosages were found effective in controlling the aphid persistence of alfa and beta endosulfan were determined. The residues were found detectable upto 16 days of application on crop.

--------, MYZUS NICOTIANAC BLACKMAN, TOBACCO BIOLOGICAL CONTROL AGENTS EFFECT OF-.

109. **LYKOURESSIS (DP) and MENTZOS (GV).** Effect of biological control agents and insecticides on the population development of myzus nictinac Blackman (Homoptera Aphididae) on tobacco. European Journal of Entomology. 52, 1; 1995; 57-64.

Samples of myzus nicotianac were taken from tobacco (tsempeli) fields near Arginio, Greece, in 1990 91. A lates appeared on the crop early in the seedbed implying anholocycly. The aphid population developed slowly for at least 4 weeks after transplanting, then endosulfan and ethiofencarb at the onset of rapid aphid increase, was very effective in controlling the and fungal diseases were the main biological mortality agents with coccinelids, syrphids and chrysopids present in low numbers. Aphid populations were higher on uper than on lower levels, the reverse begin tree for mummies. The number of parasitoids was therefore reduced by removal of leaves. Agricultural practices which could contribute to the effeteness of parasitoids and fungal diseases are discussed.

--------, **NOCTUID AGROTIS ORTHOGONIA, EFFECT OF-.**

110. **BYERS (JR), HILL (BD) and SCHAALJE (GB).** Effect of inactively asociated with interstadial molls on short-term efficacy of insecticides for controll of pale western cutworm. Journal of Entomological Society of British Columbia. 85, 4; 1992; 1146-9.

The Efficacy of sprayed insecticides used for control of the noctuid Agrotis orthogonia is retarded by 3-5 days if a substantial proportion of the population is moulting at the time of application. Larvae are inactive during a moult and remain 1-3 cm below the soil surface. In natural infestations sampled before treatment, upto 50% at the larvae were in a premelt or recent postmoult condition and not feeding. In the laboratory at constant temperature the moulting associated with the last 2 larvalinstars accounted for about-third moulting time comprises a large component of larval development in A grotinal and its effect on behaviours, including response to insecticides, had largely been ignored.

--------, **NON-PYRETHROID, PYRETHROID, SPODOPTERALITURA, RELATIVE SUSCEPTIBILITY AND DEVELOPMENT.**

111. **SINGH (DS) and SINGH (JP).** Relative susceptibility and Development of Resistance in spodoptesa litura larvae against

some pyrethroid and non-pyrethorid Insecticides Annual Review of Entomology. 19, 3; 1991;56-60.

The article deals with the development of Resistance in spodopetra, the tobacco caterphllar, spodoptera litura Fab is a serious polyphagous pest. The larvae of this pest cause severe foliar damage to the crop. The relative susceptibility of 3rd instar larvae of spodeptera litura Fab against some pyrethroid and non-pyrethroid insecticides was determined by bioassy method and compared with 2nd Instar larvae of S. litura. On the basis of LC50 value the order to toxicity of different insecticides was bulldock > bifenthrin > decamethrin > cypermethrin > chlorpyriphos > fenvalerate > malathion > endosulfan. The 2nd instar larvae were 25.7, 1.6, 1.3, 1.3, 1.6, 2.3, 0.7 and 0.9 times more susceptible to lambdacyhate thrin, buldock, decamethrin, cypermethrin, fenvalerate, malathion, endosulfan, bifenthrin and lindane then the 3rd Instar larval of S. litura.

--------, OKRA FRUITS, MALATHION, CARBOARYE, DISSIPATION OF-.

112. **DESHMUKH (SN) and SINGH (JAI).** Dissipation of carbaryl and Malathion from Okra Fruits. Journal of Applied Entomology. 37,1; 1975; 64-7.

Okra (Abelmoschus esculentus L) Monech is attached by many insect pests from the germination till maturity but Jassids, Armrasea bugutulla bigutulla (Ishida); Whitefly, Bemisia tobaci

Guen; and bollworms, Earias, are most important ones. Malathion and carbaryl are currently being recommended for the control of Jassids and borers. The present investigations were therefore undertaken with a view to study the residues of carboryl and malathion in/on marketable size fruits of Okra.

--------, OKRA, YELLOW VEIN MOSOTC, EFFECT OF-.

113. **DAHAL (G), NEUPANE (FP) and BARAL (DR).** Effect of planting and insecticides on the incidence and spread of yellow vein mosaic of Okra in Nepal. Entomological News. 10,1; 1992; 109-24.

The systematic and contact insecticides delayed or reduced the incidence of Okra (bhendi) yellow vein mosaic bigeminivirus in replicated field experiments. The disease began 3 weeks after sowing and incidence reached comparable levels in both treated and untreated plots after 45-60 d. Rates of disease increase were similar among the treated plots but differed significantly between various dates of observation. Onset and spatial development of the disease varied with observation. Onset and spatial development of the disease varied with the tune of saving; incidence was lower in may sowings than in those of Jun or Aug. The disease severely reduced both pod and seed yields.

--------, OPISINIA ARE NOSELLA WLK, COCONUT, DEVELOPMENT, ACHITIN INHIBITOR, EFFECT OF-.

114. **PATIL (RK), LANGPPA (S) and BASAPPA (H).** Effect of insecticides and achitin inhibitor on development of three parasitoids of the coconut black headed caterpillar opisinia arenosella wlr. Europeon Journal of Entomology. 7,2; 1990; 51-7.

Paralysed larvae of cercyra cephalonica with differetnt developmental stages of the ectoparasitoids Goniozes nephatidis and Bracon brevicorinis (1-9 and 1-7 days after parasitism, resp). and C. Cephalonica pupae parasitized by the endoparasitoid Trichospilus pupivora were sprayed under a potter's Tower with field concen of endosulfan (at 0.035%), fervalerate (0.1%) permethrin (0.01%) cypermethrin (0.01%) Carboryb (0.02%), chloryprijos (0.4) monocrotophos (0.02%) and the Chitin synthesis inhibter diflubenzuron (0.05%). On the basis of emergence from Treated hosts, endosulfan followed by finvalerate, killed the least parasitoids at all developmental stages. Monocrotophos and chlorpyrijos were very toxic to all stages of the parasitoids. The lolerence of the parasitoids to the pesticides increased with age, with eggs being the most vulnerable.

--------, ORGANO (CHLORINE+PHOSPHATE), AEDES TAENIORHYNCHUS, SUSCEPTIBILITY.

115. **MONTADA (D), TANG (R), NAVARRO (A) and GARCIA (FA).** Susceptibility status of Aedes taeniorhynchusto organochlorine and organophosphate insecticides. Annals of Entomological society of America. 89,2; 1994; 251-52.

The susceptibility of wild-caught late 3rd or early 4th instar larvae of A. taeniorhunchus the laboratory (in cuba), using stock solutions of malathion, function, temephes, chloryrifes and DDT. A taencorhynchus was most susceptible to chlorpyrifos 0.00043 and 0.00107 mg/litre; DDT 0.00172 and 0.00352 mg/litre, fenthion 0.00131 and 0.00318 mg/litre, fenitrothion 0.00149 and 0.00441 mg/litre, Malathion 0.02588 and 0.09535 mg/litre, and temephos, 0.00068 and 0.00152 mg/litre. The results are presented as baseline data for monitoring the development of insecticide resistance by A. taeniorhynchus in cuba.

--------, ORSEOLIA ORGANIZE, RICE, RESISTANCE, BIOCHEMICAL.

116. **SINGH (MP) and SALAM (JS).** Biochemical Basis of Resistance in Rice Against Gall Midge, Orseolia Aryzae Wood Mason. Annals of Plant Protection Sciences. 5(2); 1997; 210-12.

The rice gall midge, orseolia oryzal wood Mason is a serious pest of rice in Manipur which produces galled shoots. It has been suggested that gall formation in plants may result other

from a mechanical or chemical stimulus. The present investigation was, therefore, undertaken to waluate rice varieties against the gall midge under filed conditions and to study the difference in phenol and sugar contents of resistance as well as susceptible varieties for the identification of biochemical basis of resistance. Eleven rice varieties and lines received from the Directorate of Rice Research, Hyderabad were field tested for resistance to gall midge during 1993-94. Leaves from resistant as well as suspectible varieties of rice were collected and immediately dried in an oven maintained at 60^0C for 48 hrs. The dried leaves were ground in a willey mill, rieved and kept in a desicator. Total phenols and boend phenold were estimated as per Bray and Thjorpe and Chatlopadhyay and samaddar. Dihyarosy phenols were estimated as per Arnow's method described by Mahadevan and Sridhar (1986).

--------, **OXYDEMETON, QUINALPHOS, CHLORPYRIJOS, RESIDUAL TOXICITY.**

117. **THOMAS (J) and PHADKE (KG).** Residual Toxicity and Resistance of Chlorpyrifos quinalphos and Oxydementon. Bulletin of Entomology. 55;3;1993; 275-80.

Thomas and Phade (1992) evaluated the field efficacy of chlorphripos quinalphos and oxydemeton - methyl against mustard aphid lipaphis crysimi (Kalt). Infesting rape seed crop variety Pusa Kalyani the investigations were further continued to evaluate the effectiveness of these insect wides against the

aphid through laboratory bioassay. The Experiment was carried out in a randomized block design with eight treatments including central replicated thrice using the seed of rapeseed crop variety Pusa Kalyani. Sowing were done on 29th Oct, 1986. The plot size was 9 sq. m with 5 rows, 60 cm apart keeping plant to plant distance at 20 cm. All recommended agronomic practices were followed in raising a good crop.

--------, PADDY, CNAPHALOCROCIS MEDINALIS HEPTOCORSIS, EFFECTIVENESS.

118. **VERMA (RA) and GUPTA (AK).** Effectiveness of some Insecticide Against Cnaphalocrocis Medinalis and heptocorisa Varicornes on Paddycrop. Indian journal of Applied Entomology. 63, 1; 1999; 71-7.

Rice is a basic foodcrop for a large proportion of the worlds population. In a field experiment seven emulsifible concentrates, insecticides @ 250 nalifha were sprayed after 15 and 60 days of transplanting the paddy crop against cnaphalocrocis medinalis Gn. The spray of quinalphos and phosphamidous effectively reduced the pest population utp 88.17 and 87.44 consequently increased the yield of paddy 17.92 and 16.24 g/ha them other treatment including control, the percentage reduction of pest-population and corresponding increase of paddy yield q/ha by the other treatments remained in fenthion (82.24, 13.08), chlorpyriphos (80.00, 9.96); lindance (79.91, 8.72); oxydementon methyl (79.81, 8.44) and

phenthoate (74.81, 6.20). Three to five days of spraying was found most effective.

--------, **PADDY CROP, NEPHOTETLIX VIRESCESS, GRANULAR, EFFECT OF-.**

119. **GUPTA (AK) and VERMA (RA).** Comparative Effect of Some Granular Insecticides Against Green Leaf Hopper (Nephotetlix Virescns) on Paddy crop. Bulletin of Entomology. 63, 2; 2001; 109-13.

In a replicated trial, seven granular insecticides viz. Phorate G. endosulfan D, Carbofuran G, aldicarb G, sensulfothion G, isogenphos G, and disulfaton G @ 1.5a i/ha were applied at the time of transplanting against Nephetettix virescens Dist. The a dilcarbs effectively, reduced the pest population and corresponding increase of Paddy yield by 85.90 per cent and consquently increased of Paddy yield quintal per hectare in other treatments over control was isofin phos (19.03, 36.58) phorate G, (77.72, 35.05); disulfaton G, (74.83, 31.08); endosulfan G, (74.58, 28.86); Carbofuran G, (70.83, 27.44) and jensulfothion G (69.41, 25.22) respectively. Rice cropis basic food and is attacked by pests right from the time of sewing. Among the various insecticides recommended against these pests only few recommendations have been evolved as a result of examination.

--------, **PARASITES, MOSQUITOES, BOREDISEASE.**

120. **MCCARROLL, PATRON, KARUNARATNE, JAYASURYA.** Insectides and mosquito-borne disease: Insecticides resistance in mosquitoes can also interfere with developing parasites. Journal of nature. 407, 4; 2000; 961-62.

The article deals with insecticide resistance in mosquitoes. Almost 80% of the insecticide susceptible and resistant mosquitoes collected were infected with wachereria bancrofli. The reduction in parasite RNA in insecticide - resistance gave frequencies were similar in infected mosquitoes, in field caught mosquito larvae, and in uninfected mosquito adult blood meal sizes were also comparable for the resistant phenotype. Artificially feeding insecticide - resistant and insecticide susceptible mosquito colonies respectively with blood infected by W. bancrofli to an intermediate level of parasitaemia which should result in the infection of mosquitoes without substantial insect mortality.

--------, **PARASITE NEMATODES, MYLONCHULUS MINOR, BIOCONTROL.**

121. **CHOUDHURY (BN) and SIVAKUMAR (CV).** Biocontrol potential of mylonchulus minor against some plant Parasite Nematodes. Indian journal of Plant Protection. 8, 1; 2000; 53-7.

The biocontrol potential of mylonchulus minor was studied against a few plant parasite nematodes in sterlized as well as

field soils. The predator was not found to be a potential biocontrol agent. The predation on these nematodes was more when the predator was added periodically at an interval of 20 days. The reduction in plant parasite nematodes, however, did not significantly improve the growth of host plant. The possibility of control of plant parasite nematodes using predatory nematodes specially the monochs has been both claimed and doubted Bilgrami and Kulshreshta (1993) reported that all the stages of M. minor were predatory against juvenilos of meloidogyne incognita and Tylenchulus semipenetrans in artycial media.

--------, PEA, CALLOSOBRUCHUS CHINENSIS LINN, GRAIN, EFFICACY OF-.

122. **LEMKE (LA), PATTERSON (RS), FEGER (MB) and DOWNUM (KR).** Efficacy of different Indigenous Plant products: As Grain Protectant against callosobruchus Chinesis Linn, on pea. Entomological News. 33,4; 1991; 315-17.

The pulse beetle, callosobruchus chinesis linn is the major insect pest of pea causing substantial loss in the storage. Considering the importance of the pests grain with in indigenous plant products viz, leaf powder of lantana, sadabahar, neem, madar and kali tulsi 10 kg grain and oils of castor, neem and mahua 2 ml/kg grain to develop the sofer products for its control. The efficacy of various products was assessed on the basis of persent grains damage and percent loss

in weight. The result revealed that neem oil and neem leaf powder appeared to be most effective to minimize the damage by the pest in grain being 2.06 and 2.66 percent respectively as against 69.63 percent in untreated grains followed by the treatment of castor oil.

--------, **PEA, FUSARIUM WILT, BREEDING FOR FUSARIUM WILT.**

123. **SHARMA (RP), SHARMA (RK) and MUNSHI (AD).** Breeding for Fusarium wilt Resistance in Pea. (Pisum sativum L.). Indian Journal of Plant Protection. 6,1; 1998; 1-10.

The world over pea crop occupies on area of 8 million ha with a production of 14.53 million tomes first reported in 1918, Fusarium wilt is an important disease of this crop causing dwarfing, colour loss, wilt and ultimately collapsing of the plants. A temp range of 21^0C to 24^0C, low nutrition, wet soils and low pH favour the workers are the promising sources of resistance. There are four races viz 1,2,5 and 6 and the resistance to all these four is governed by four different dominant genes, Back crop Pedigree and their modifications have been used maximum to breed resistant varieties, 15 of which are listed Future strategy for further strengthening the breeding efforts is suggested. The garden pa (Pisum satium0 a typical representative of the sub family papiliomacease under the family leguminoceae is one of the principal winter vegetables in India.

--------, **HYBRIDS, NEWLY DEVELOPMENT; RESISTANCE.**

124. **PREM KISHORE.** Insect resistnce in newly developed hybrids and populations of peare milet. Bulletin of Entomological Research. 17, 4; 1993; 327-30.

Forty-six newly developed hybrids and reaction to shootfly, Atherigona approximata Malloch; stem borer, chilo partellus; grey weevil and leaf roller. The new sources exhibiting resistance comprised three entire MH 365, MH475, MH491 to shootfly; seven entrees to MH 427, MH 432, MH456, MH475, MH 491, MH219, MH241 to stem borer; two entries MH 419, MH420 to grey weevil and MH 419 to leaf roller. These were selected as highly promising sources of resistance. The entries which showed high susceptibility to different pests were MP 255, HC 4 (stem borer) and MHB67 9grey weevil and leaf roller). Three entries viz MH420, MH485, MH491 can be selected for multiple pest resistance though not showing minimum damage in entirely to these pests.

--------, **PECTINOPHORA GOSSYPIELLA, PINK BOLLWERM, PYRETHROID-RESISTANCE.**

125. **SAXENA (JD).** Pyrethroid-Resistance is field Populations of Pink Bollowrm Pectinophora Gossypiella Saunders in India. Indian Journal of Applied Entomology. 54,3; 1992; 347-50.

Synthetic Pyrethroids have been reported to be very effective against pink ballowrm pectinophora gossypulla saunders, which is a serious pest of cotton. Mainly three pyrethroids viz, fenvalerate, cypermethrin and deltamethrin were commercially used since their introduction during eighties in India. Among these synthetic pyrethroids fenvalerate was found to the most effective, while cypermethrin and deltamethrin were foun superior to carbaryl and monocrotophos which were currently recommended for bollworms control. However, in recent years, it was experienced that control of pink boll worms through application of these synthetic pyrethroids was not found satisfactory present studies were undertaken to monitor the level of resistance developed in field population of P. gasspiela.

--------, PEST CONTROL, PEACK APHID, SPECTRUM OF RESISTANCE.

126. **KEGEL (B).** Spectrum of resistance of the peach aphid, acquired under the influence of insecticides and choice of preparation for pest control. Journal of Applied Entomology. 52,2; 1992; 144-55.

The article deals with the spectrum of resistance which was carried out of 8 populations of myzus persical resistance to various insecticides. It was shown that treatment with pirimiphos methyl and etaphos resulted in the development of group resistance to organophosphates and inter-group resistance

to synthetic pyrethroids. The influence of high group resistance and inter-group tolerance to organophosphates. Recommendations are given for overcoming resistance and for choosing preparations to control M. persicae dependign on the level and type of acquired resistance.

--------, **PEST, SUGARCANE, DEVELOPMENT, IMPROVEMENT OF-.**

127. **VILAS BOSE (AM), PACCOLA and ALVES (LUNA).** Development and improvement of Diological insecticides for pest control. Annals of Applied Biology. 35,4; 1992; 49-55.

This articles deal with the development and improvement of bilogical insecticides. Three ultraviolet resistance mutants were obtained from strain PL256 and 2 from strain PL196. The viability of the wild and mutant strains was tested by incorporating a suspension into the soil or by applying it to the surface a field of newly emerged sugarcane or by applying the suspension to the soil surface of a field of 6-month old sugarcane. Soil samples were collected 0,25, 50, 75, 100, 125 and 150 days after application. All applications to the field of newly emerged sugarcane lost > 50%. Viability within 75 days. While the application of mutant strains to 60 month old sugarcane retained up to 70% viability for 125 days. PL2561 was selected as the most resistant strain.

--------, PEST, VECTORS, USE OF PRESENT STATUS AND PROSPECTS.

128. **GUILLET (P), CHANDRE (F) and MOUCHET (J).** Use of Insecticides in Public health; present status and prospects. Annals of Entomological Society of America. 27; 1997; 552-57.

Insecticide control is an essential tool in the prevention of vector borne diseases and pest control. In some cases, it is the only tool available (dengue, chagas disease) significant progress has been made in the development of new and more selective control methods of new and more selective control methods based on community particupation. They are better in tune with the decentralized policy of primary health care promoted by WHO. Pyrethroids.

--------, PHYLLOTRETA CRUCIFERAE, CRUCIFER FLEA BEETLE, RESISTANCE DEVELOPMENT.

129. **TURNOCK (WJ) and TURNBULL (SA).** Development of resistance to insecticides by the crucifer flea bettle, phyllotreta cruciferac. Journal of Agricultural Entomology. 126;6; 1994; 345-48.

The contact toxicities of 11 insecticide were determined with a potter spray tower using adults of phyllotreta cruciferae. Beetles collected from an experimental farm, ontario, where no insecticides had been used, were compared with those grom canola-growing areas near saslection, saskatchewan and

wevinipeg, manitoba. Lindane, in a seed dressing is widely used in both saskatchewan and Manitoba, cohereas carbofuran as in-furrow granules, has been more heavily used in Manitoba than in saskalchewan. The beetles from wininpey were significantly less susceptible to all 3 carbomates tested than those from saskation. These differences may indicate resistance in the Manitoba population but this low level would not affect the efficacy of the currently recommended insecticides. The results emphasize the need to develop control strategies that will minimize the Chanres that the level of resistance will increase.

--------, PIGEON PEA, POD FLY AND POD BORER.

130. **NARENDRA NATH SINGH.** Economics of use of Insecticides Against Pod Fly and Pod-Borer complex on Pigeon Pea. Journal of Applied Entomology. 59, 2; 1997; 228-31.

Pigeon-pea is one of the most important pulse crop in India, failed experiments were conducted at the Research from Institute of Agricultural Sciences, Banaras Hindu University, Varansi during the year 1994 and 1995 to study the economics of various insecticudal treatments applid for control of Pod fly and podborer complex on pigeon pea. In case of three sprays of fenitrothian, the additional return was less than the cost of control. The other insecticidal treatment resulted in an additional return over cost of treatment ranging from Rs. 396.00 to Rs. 703200 per hectare. The maximum benefit was received from three sprays of quinalphos. However, one sprays of

endosulfan offered higher benefit cost ratio as compared to three sprays of quinalphos.

--------, PISUM SATVUM, WEEDS, CROP LOSSES.

131. **KUSHWAHA (HS), CHAUHAN (YS) and RAGHU (JS).** Crop Losses due to weeds in Pea 9Pisum sativum L.). Annals of Plant Protection Sciences. 7,2; 1999; 208-11.

Field studies carried out at Central Research farm, Gwaliar during 1994-95 and 1995-96 revealed that in field pea, the seed yield losses due to weeds infestation were 574 to 817 kg grain ha^{-1} depending upon the yield potentials of the varieties. This caused a a net loss of Rs. 8196 ha^{-1} on an average due to weeds infestation. Pea (Pisum sativum L.) is grown in Rabi season occupying an area of 0.45 million ha in India which is about 2% of the total area under pulses. In Madhya Pradesh, the total area under pea cultivation was estimated to be 0.123 million ha. The average grain yield of pea was 379 Kg ha^{-1} (Jeswani 7 Baldev, 1990). Main constraints were lack of plant protection measures, weed control and growing the crop under un-irrigated conditions. The present study was undertaken to determine the losses of grain yield of pea in northern part of Madhya Pradesh under irrigated condition.

--------, PLANTAGO OVATA, ISABGOL, GOSSYPII GLOVER, APHID, EFFICACY OF-, PUNJAB.

132. **PREM SAGAR.** Efficacy of Insecticides Against the Aphid, Aphis Gossypii Glover on Isabgol, Plantago Ovata in the Punjab. Indian Journal of Agricultural Sciences, 54, 4; 1992; 399-01.

Isabgol, Plantago ovata, Forsk is commercially grown as a winter crop in several parts of India for its seeds, which have medicinal and Industrial significance. As such it enjoys flourishing export market. In the Punjab cultivation of isabgol is recommended in distructs of the southwest such as Bhatinda, Derozpur and Faridkot. The crop is attacked by a number of insect pests (Anonymous 1981). Aphis gossypii Glover has been reported on arum, ash-gourd, bitter ground chillies, cotton Datura spp., songe-gourd. Tagetes erecte Tecoma stants and Vegetable Marrow. In view of the danger to the isabgol crop from this pest efficacy of eight insecticides (Six already lested in 1984) was determined and the findings are presented here.

--------, **PLUTTLLA XYLOSTELLA, CABBAGE, VARIETAL RESISTANCE.**

133. **NATHURAM, RAJU (SVS) and SINGH (HN).** Varietal Resistance of Different Cabbage Varieties/Entries Against Plutella Xylostella under Field conditions. Indian Journal of Agricultural Sciences. 62, 2; 2000; 175-80.

This abstract shows that ten selected cabbage (Brassica oleracea L-var capitata) varieties/entries were evaluated in the

BHU Research Farm or their reaction to P. Xylostella (Linn.). Based on diamond back month infestation index (DBMII) and mean yield, pride of India and Pusa drum head were found to be highly resistant and Pusa synthetic Golden area, Sri Ganesh Gold, Nath 50, Pusa Mukta and BRH5 exhibited of moderately resistant. The least resistant reaction to DBM was observed in case of quiesto and copenhagen market. The weekly population count on 10 test varieties/entries revealed that highly resistant varieties harboured significantly lowest population of P-xylostella and gave higher yield as compared to moderate and least resistant varieties/entries respectively. However absolute resistance could not be observed in case of any of ten test varieties entries of cabbage under the present study.

--------, **PLUTTELA NYLOSTELLA, DIAMOND BACK-MOTH, EFFICACY-.**

134. **KOTEWSARAN 9SR) and LAL 9OP).** Efficacy of different insecticides against diamond back moth, Pluttella nylostella L. on cabbage. Journal of Entomological Research. 25, 2; 2001; 161-64.

This articles describes that number of insecticides belonging to different group were used on cabbage belt the resistance is still growing. Cabbage is commercially important cruciferous vegetable crop grown all over the world. The successful cultivation of cabbage is hambered by diamondback moth, which is a serious pests of cruciferous crops. The present

investigations were carried out to study the efficacy of insecticides belonging to different groups against diamond back moth, on cabbage, take cartap hydrochloride 0.05%, diltamethrin 0.002% endosulfan 0.07% and imidacloprid 0.01% gave maximum larval mortalities. A chook was least effective against larval population of P. xylostella.

--------, **POCKILOCERUS, INSECTICIDAL DUSTS, HOST-PLANTS, SEASONAL INCIDENCE.**

135. **SINGH (VC) and DHAMDHERE (SV).** Seasonal Incidence, Host Plants and Toxicity of Insecticidal Dusts against Poekilocerus Picture. Environmental Entomology. 58,4; 1996; 322-25.

Calotropis popularly known as 'AKH' or madar grows wildly. The feliage of this plant is largely used as green manure in wet lands. During the present studies in the summer season at Gwaliar. It damage cucurbitaceous plants. It fed both in situ and laboratory conditions on 16 host plants belonging to three families. It fed both in setu an laboratory condition on the basis of leaf area consumed in 24 hr. by an adult grasshopper bottle gourd was found to be highly preferred host followed by cucumber. The pest was active from the first week of July but maximum population was in the third week of June on bettle gourd of the 7 insecticidal dust tested against the pest, endosulfan and BHC were moderately toxic to adult grasshoppers.

--------, **POTATOES, AGROTIS IPSILON, NEEM FIELD EVALUATION OF-.**

136. **RAM KISHORE and MISRA (SS).** Field evaluation of synthetic insecticides and neem cake for the management of cutworm, Agrotis ipsilon (Hfu), damaging potatoes in different agroclimate zones of India. Journal Entomological Research. 25,1; 2001; p. 31-5.

This articles deals with the insecticides used on potato the insecticides like DDT, BHE, aldrin, dieldrin, heptachlor, toxaphene etc. which were being recommended for controlling potato cutworms in the past but these were unable to control over the insects. In the last three year experiment from 1992-94 at Modipuram spraying of potato foliage and ridges with chlorpyrifos 20 EC twice was found to be the best treatment for suppressing the damage of cutworm. So other insecticides like endosulfan, quinalphos, phorate and carbofuran may also be used.

--------, **POTAO BEETLES, ESFENVALERATE, RESISTANCE.**

137. **MIYO (T), KEIL (CBO), HOUGH (JA) and OGUMA (Y).** Inheritance of Resistance to Esfenvalerate in colourdo Potao Beetles. Journal of Economic Entomology. 95, 5; 1999; 1031-35.

Colorado potao Betle is a major insect pest of potao in the united state. The causes of rapid resistance development in colorado potao bettle populations include high population growth rate the bettles, frequent insecticide usage. Pyrethroid resistance in colarado potato beetles was detected in 1978. In addition to direct application for colorado potato beetle management, pyrethroid insecticides have been widely applied to control pests of many crops including cabbage, corn and soybean. They proposed that resistance to fenvaleerate was caused by a semi recessiue, sex-linked gene where as carbofuran resistance was caused by a partially dominant.

--------, POTAOTES, FOLIAR SYSTEMIC, DISSIPATION.

138. **MISHRA (SS).** Dissipation of Residues of Foliar Systemetic insecticides in Potaotes Grown in North Western Plains. Journal of Applied Entomology. 54, 4; 1992; 440-47.

The aphids of paramount economic importance so far as the cultivation of healthy (virus free) seed crop of potatoes is concerned. The losses caused by them are formidable 9verma and Misra 1975) of all the Aphid species associated with potato crop, two viz. Myzus persicae 9sulzer) and Aphis gossypii Glover merit special attention for monitoring and control. Their role is as vectors of viruses. In India, the losses in potato yield due to potato leaf-role virus (PLRV) and potato virus Y (PVY) were testimated to be 20 to 50% and 40 to 80%. Foliar systematic insecticides sprayed on foliage for aphids control do

reach upto the potato tubes underneath because of their systematic properties and the potatoes harvested from such sprayed crops are although supposed to be used for seed but out and over undersized potatoes. Hence, it is essential that effective foliar systematic insecticides be evaluated from residues angle for safeguarding the consumers thaken for estimating the residues of demeton methyl, dimethoate and thiomelon EC's in potatoes.

--------, POLYHEDROSIS VIRUSES, INSECT SPECIFIC ENZYME INSECT-SPECIFIC TOXIC.

139. **HAMMOCK (BD) and MCCUTCHEN (BF).** Development of recombinant viral insecticides by expression of an insect-specific toxic and insect-specific enzyme in nuclear polyhedrosis viruses. Entomological News, 22; 1993; 315-44.

As supplements to the classical chemical insecticides, 2 approaches to develop recombinant baculovirus [Baculovirdae] insecticides are described. In which reduce a dramatic reduction in the time to death. In the 2nd approach, an insect juvanile hormone esterase was expressed which reduced insect feeding. In both cases, existing recombinant viruses are viewed as new chemical leads and approaches to further improvement in the engineered viruses are suggested. Using these viruses as examples the potential utility and limitations of recombinant viruses and other biological insecticides are discussed. This paper was presented at the united states, Israel Bardworkship on

New Targets for Insect Management in crop protection held in Israel on 5-10 Oct., 1991.

--------, **POTATOS MYZUS PERSICAE, GREEN PEACH APHID, EVALUATION OF-.**

140. **SINGH (UC) and NARWARIA (LS).** Evaluation of Insecticides Against Green Peach Aphid Myzus Persicae in Potato. Indian Journal of Entomology. 59,1; 1997; 98-102.

Investigation carried out to find out the effect of six insecticides on green peach aphid, Myzus persicae revealed that all the insecticidal treatments reduced aphid population effectively and among themselves they were similar. Methyl demotion was found most effective Despite similarity in reducing the aphid population, yield of potato tubers under different treatments differed significantly. Potato is important vegetable crop and India is the second largest producer of the crop in the world. The crop is attacked by number of insects pests. Some workers have tested insecticides against the pest 9Narula, 1962; Sarup et al., 1967; Azeez and Balasubramanian, 1980, Maheswari, 1981) but no work appears to have been carried out in Madhya Pradesh except Singh and Mishra (1985). Therefore, the present studies on evaluation of insecticides were carried out.

--------, **PULSES, WHITEFLY, EFFICACY OF-.**

141. **GOPA (M), MUKHERJEE (I) and SRIVASTAVA (KP).** Efficacy of Imidacloprid and its comparison with other Insecticides for controlling white fly in Pulses. Indian Journal of Plant Protection. 5,1; 1997; 29-33.

Studies were undertaken to determine the efficacy and persistence of imidacloprid used for the control fo whitefly and yellow Mosaic virus in two pulse crops seed treatment with imidacloprid reduced the population of whitefly in black gram and soybean. Higher grain yield recorded where imidacloprid treated seed were sown. Imidadacloprid was estimated by high pressure liquid chromatography (HPLC) and its residues were below detectable limit (LO 1mg kg^{-1}) in harvested grains. Whitefly Bemisia tabaci is a vector fly for the incidence of yellow mosaic virus (YMV) in pulse crops, namely black grain and soybean. The efficacy of various insecticidal treatments was determined by taking observations on average number of white files per leaf, percentage YMV incidence at harvest and the yield.

--------, **PYRETHROIDS AND NON PYRETHROIDS, SPODOPTERALITURA, RESISTANCE RELATIVE SUSCEPTIBILITY AND DEVELOPMENT.**

142. **SINGH (DS) and SINGH (JP).** Relative susceptibility and development of resistance is spodoptera litura larvae against some pyrethroid and non pyrethroid insecticides. Journal of Research-ANGRAU. 60,2; 1998; 177-80.

The relative susceptibility of 3rd instar of spondoptera litura fab to some pyrethroid and non pyrethroid insecticides was determined by bioassay and compared with 2nd instar larvae of S. litura on the basis of LC50 value the order of toxicity of different insecticides was: Bulldock > fifenthrin > decamethrin > cypermethrin > chlorpyrifos > fenvalerate > malathion > endosulfan. The 2nd instar larvae were 25.7, 1.6, 1.3, 1.6, 2.2, 6.3 and 0.9 times more susceptible to lambda - cyhalothrin. Bullock, deltamethrin, cyper methrin, chlorpyrifos, fenvalerate malathion, endosulfan, bifenthrin and lindane than the 3rd instar larvae of S. litura.

--------, **PYRETHROID, PYRETHRIN, NEUROTOXICITOGY.**

143. **DORMAN (DC), BEASLEY (VR).** Neurotoxicitogy of Pyrethrin and the Pyrethroid insecticides Entomological News. 33,3; 1991; 238-43.

Pyrethroid insecticides are neurotoxic and the developmetn and severity of clinical signs in propotional to the serious tissue pyrethroid concentration. Type pyrethroid posioning in mice and rat produces a systreme characterized by tremors prostration and altered startle reflexes. Type II pyrethroid poisoningin mice and rats causes ataxia convulsions, hyperactivity, choreaothelosis and proguse salivation a presumptive diagnosis of pyrethrin/pyrethroid poisoning is based upon history of exposure development of residues.

Treatment of pyrethrin and pyrethroid toxicity involves basic life support, seizure control when needed and the prevention of further insecticide absorption.

--------, **RABIOMION, ONION THRIPS, EFFECT OF-.**

144. **GUPTA (PP), SRIVASTAVA (PK) and BHARDWAJ (BS).** Effect of diffferent combinations schedule of Insecticides on the control of Onion thrips in rabı Onion. Bulletin of Entomology. 18,2; 1991; 209-13.

The effects on Thrips tabaci on onions in Haryana, India in 1984-87 of various combined treatments of Malathion (0.05%), Methyl demethon [Demethon-Methyl] (0.05%), endosulfan (0.07%), Phorate (1 kg al/ha), carbofuran (1 kg ai/ha) and fenvalecrate 0.07% were investigated. Combination treatments of Carbofuran+ Malathion+ Fenvalerate, phorate+ Malathion+ Fenvalerate and phorate + Malathion + Methyl-demeton [demeton-methyl] gave the greatest reduction in incidence of the pest, from 98.33% in the control to 69.17, 71.67 and 74.17 in the treated plots. Following comparison of costs to benefits, it was concluded that basal application of granules of phorate at planting followed by the spray of Malathion when thrips prepared and a further spray of fenvalerate after 15 days, was the best treatment.

--------, **RESISTANCE MANAGEMENT, LINDANE.**

145. **SAXENA (VS) and SHARMA (KK).** Lindane by product in the Management of Insecticide Resistance. Journal of Agricultural Sciences.54,4; 1992; 428-32.

Factors like penetration, distribution and metabolism of insecticide in various parts and pattern of lipids in subcellutar fractions influence, the mechanisms of resistance in insect pest meanwhile excessive use of chemicals in agriculture and public health programme rendered many Insect species resistant to various chemicals Georghiou (1968) listed 448 insect species resistant to different pesticides out of which 34.34% were resistant to DDt alone. In the wake of search for alternative use of inactive isomers of lexachlorocylophexane chifly l-isomer technology of 'anti-resistant insecticidal formulation' was developed and patented for the control of various resistant pests. Carbamates (Tomar and Rao 1990) Dydercus Koeniquii and Dicracia obliqua. It was to illustrate the influence of l-HCH on the melabolism of DDT in DDT resistant houseflies.

--------, **RESISTANCE, MECHANISM**

146. **OTTO (D) and WEBER (B).** Insecticides, mechanism of action and resistance. Environment Entomology. 35,1; 1992; 490-93.

This articles deals with a comparison which was made of the effectiveness of using rational mixtures of insecticides with that of other types of insecticide application including rotation

and checkboard systems in delaying resistance development of a pest insect species. The results showed that under favourable conditions the effectiveness of a rational mixture is the same as that of rotation, but better than that of checkboard. Under unfavourable conditions caused by a high original frequency of the resistance geve, low dilution action etc. the rational mixture strategy is obviously better than the other 2 methods.

--------, RESISTANCE, PARASITES, MOSQUITOES PARASITES DEVELOPMENT.

147. **PATON (MG), KARUNARATNE (SH) and HEMINGGWAY (J) and JAYASURYIA.** Insecticide resistance in mosquitoes with developing parasites. Natural Enemies of Insects. 42, 2; 2000; 96-9.

This article deals with the Insecticide resistance in mosquitoes. Culex quinquefasciatus were collected from the houses of filariosis patients in seven districts of Sri Lanka. Mosquitoes were analysed for parasite load and for insecticide resistance. Almost 80% of the insecticide suceptible and resistant mosquitoes collected wee infected with Wuchereria boncrofti. The reduction in parasite RNA in insecticide-resistance gone frequencies wer similar in infected mosquitoes in field-caught mosquito larvae and in uninfected mosquito adults were also comparable for the resistant phenotype. Results indicate that an increase in esterase activity could affect the development of W. bancrofti larvae, which may be arrested in

the get cells of insecticide - resistant but not insecticide susceptible mosquitoes.

--------, **RHOPALORIPHIM MAIDIS, MAIZE APHID RESIDUAL TOXICITY OF-.**

148. **SINGH (MR), MARWAHA (KK) and SINGH (DS).** Residual Toxicity of some Insecticides against Maize Aphid Rhopalosiphum Maidis. Journal of The Kansas Entomological Society. 60, 4; 1998; 402-07.

Corn aphid, Rhopalosiplum maidis fitch is a sporadic to serious pest of maize. Residual toxicity of phosalone 35 Ec, chloryriphos 20 EC and phenthoate dust 2.0 percent against Rhopalosiphum maidis. Fitch was studied by exposing field collected aphids for 24 hours to maize leaves treated with three concentration i.e. o.025, 0.05, 01 and phenthoate dust 2.0%. The order of relative efficacy was phenthoate dust 2.0 followed by chlorpyriphos 0.1, phenthoate 0.1, chlorpyriphos 0.05, phasalone, 0.1, phenthoate 0.05, phosalone 0.05, phenthoate, 0.025, chlorpyriphos 0.025 and phosalone 0.025 percent. Though phenthoate dust 2.0 percent manifested higher aphid toxicity visa-vis emulsifiable concentrate of phosalone, chlorpyriphos and phenthoate but amongst sprays chlorpyriphos was inherently more toxic to corn aphid.

--------, **RICE, HYRICULARIA ORYZAE, RESISTANCE SLOW.**

149. **MUKHERJEE (AK), SURIYARAO (AV) and NAYAK (P).** Stable slow-blasting Resistance in Rice. Annals of Plant Protection Sciences. 6,1; 1998; 11-18.

Twenty five rice genotypes were evaluated for identification of stable resistance to leaf blast caused by pyricularia oryzae Cav; under four environments. (seasons). Significant genotype - environment interactions were observed in the material under investigation. Fourteen genotypes with low mean disease score no response in their disease reactions to environmental changes (bi=0) and minimum deviation from regression ($S^2d=0$) were identified as possessing above average stability for leaf-blast resistance. The genotypes Surjamukhi and N-22, with moderately low mean disease score, unit regression coefficient (bi=1) and minimum deviation from regression, possessed average stability. Boạrd the linear and non-linear components of stability parameters along with the mean disease response were considered important for evaluation and identification of stable slow blasting rice genotypes.

--------, --------, **INSECT PESTS, IMPACT OF PLANTING TIME.**

150. **SONTAKKE (BK) and PANDA (SK).** Impact of planting Time, Host plant Resistance and Need Based Chemical Control on major Insect Pests of Rice in Orissa. Annals of Plant Protection Sciences. 7,1; 1999; 40-5.

Field experiments were conducted at Regional Research Station (OUAT), Chiplima from 1992 through 1994 in Kharif seasons. Two rice Cvs. Swarna (Susceptible) and Bhuban (Moderately resistant). were raised in early, normal and late plantings and under protected conditions separately. Both the variety under early planting recorded the lowest incidence of skin borer, gall midge and planthoppers under both protected and unprotected conditions as compared normal and late plating. Irrespective of planning time, rice Cv. Bhuban harboured fewer insect pests than the susceptible Swarna but recorded identical yield under Unprotected condition. Variety Swarna required greater number of insecticidal applications than Cv. Bhuwan, however it gave highest profit under all the dates of planting with higher benefit; cost ratio. In the present investigations three components of IP < V/Z. altered planting host plant resistance and need based insecticidal application against the major pests of rice have been investigate.

--------, --------, STALK-EYEDFLY, EFFECT OF-.

151. **JOSHI (RC).** Effefct of Early Insecticides Spraying on Stalk-Eyed fly Damage and Rice yields in Nigeria. Journal of Insect Behaviour. 54, 4, 1992; 369-75.

There are more than 80 species of Phytophagous insect attacking rice in tropical Africa. The insect lays eggs on the rice seedlings while on the nursery beds. The larvae feed inside the rice tillers, as a result the central leaf where does not unfold,

turn brownish and dries out such symptoms are known as dead-hearts. Thereafter, the damage begins to decline as the plant materials. This insect is rarely capable of producing white heads. The damage resulting from attack during the reproductive phase of the plant. Many researchers in Africa reported yield losses by D. longicornis ranging from 1.9 to 97 percent.

--------, RICE STEM BORER, VARIETAL RESISTANCE, EFFECT OF-.

152. **SONTAKKE (BK), PANDA (SK) and RATH (LK).** Effect of Data of Planting Varietal Resistance and Chemical Control on Rice Stem borer incidence in Western Orissa. Indian Journal of Applied Entomology. 59, 4; 1997; 423-29.

The stem borer, scrrpophaga incertulas coalker is a major pest of nice in Orissa. Large scale cultivation of high yielding high fertilizer responsive rice varieties coupled with assured irrigation have increase its severity in Western Orissa. Field experiments were conducted at the Regional Research Station (OUAT). Three components of 1Pm viz time of planting varietal resistance and need based application of insecticides were studied against rice stem borer. Both the varieties under early planting records the lowest stem borer incidence under both protected and non protected conditions as compared to normal and late plantings irrespective of planting times, rice variety Bhuban had less incidence of stem borer that of

susceptible swarna. In all the cases rice variety Swrana recorded higher gram yield under protected condition.

--------, **ROUND-BOHAI, COTTON BALLWARM, COORDINATED DEVELOPMENT.**

153. **KONGMING (MW), YUYUAN (GUO) and GUO (YY).** Coordinated development and analysis of contributing factors of cotton bollowrm resistance to insecticides in Round-Bohai Boy-Region. Korean journal of Entomology. 27,2; 2000; 173-78.

The cyhalothrin, phoxim and endosulfan resistance levels of cotton bollworm, Helicoverpa armigera, colelcted from 16 locations in Round Bohai Bai-Region were determined as 65.43-442.0, 10.28 and 6.34-29.17 fold respectively. No significant differences were detected in the same year among the populations from the southern, middle and northern areas where the spraying frequency of insecticide in crop fields differed. After rearing in the laboratory for 17 generations without insecticide treatment, the resistance of the liaoyang strain to cyalothrin, phoxim and endosulfan decreased from 213.71, 34.53 and 8.5 fold to 3.0, 3.54 and 1.96 fold. It is suggested that cotton bollowrm populations in middle and northern parts around the Bohai sea immigrate from the south.

--------, **SAFFLOWER, CHEMICALS TREATMENTS INFLUENCE OF-.**

154. **CHARJAN (SKU) and TARAR (JL).** Influence of seed treatment with insecticides and fungicides on germination and seedling development of safflower. Journal of Entomological Society of British Columbia. 2, 2; 1991; 131-34.

The effect of seed treatment with dimethoate, phosphamidon, monocrotophes or methyl demeton [demeton-methyl] (at/ 2 or 3 ai.i.) and carbendazim, captan, captafol and thiram (at 0.1, 0.2 ot 0.3 a.l) on germination of safflower was investigated in the laboratory Treatments with phosphamidon (1 or 2 a.i.) and monocrotophes (1 or 2 a.i.) were preferred over the other insecticides. None of the fungicides had any adverse effect on germination or seeding growth.

--------, **SCHISTOCERIA GREGARIA, BOITIC INHIBITION, EFFECT OF-.**

155. **NASSEH (O), KRALL (S), WILPS (H), SALISSOV (GB) and NASSEH (OM).** Effect of growth inhibitors and of biotic insecticides on larvae of schistocerca gregaria. Entomological News. 45; 1992; 5-19.

In cage experiments in 1990-91 in the Tamesna desert Niger the effect of the growth inhibitors Alsystin (triflumuron) and indica and Melia volkensis on immature Schistocerea gregaria were investigated. The growth inhibitors and neem extract caused 100% mortality in 8-13 days, while the extracts from M. volkensii delayed developed. Thus the resistance was created.

--------, **SEED CORN, INSECT PESTS, INSECTICIDES, EFFICACY OF-.**

156. **ARTHUR (FH).** Efficacy of three insecticides to control insect pests of stored seed corn. Annals of Entomological Society of America. 12, 1; 1995; 45-8.

Begged seeds of Maize treated with ready to use pirimiphos methyl (2) (Actellic) at 2.27 kg a.i. /3.784 litres, chlorprifos at 1.36 kg a.i./3.784 litres or distilled water were stored in an unheated shed was artificially infested with Tribolium castaneum sitophilus Geamais and Plodia interpenctella. Measure residue deposition at month 0 for primiphos methyl (1), 2 Chlorpyrojos was 1.74 ± 0.16, 6.86 ± 1.06 and 7.08 ± 1.58 p.pm, respectively. After 10 months residues had declined to 0.61 ± 0.07, 2.03 ± 0.08 and 2.78± 0.51 ppm. Respectively. Insect populations in untreated maize remained low. Few line specimens of P. treatments at months 10. Both pirimiphos methyl and chlorpyrifos are suitable prolectants for seed maize.

--------, **SESANUM, TERMITES, EVALUATION OF-.**

157. **PANDA (P), PANIGRAHI (D) and SASMAL (A).** Evaluation of some Insecticides against Termites on seasamum in Orissa. Annals of Plant Protection Sciences. 6, 1; 1998; 118-20.

Sesamum (Sesamum indicum 1) is an important oilseed crop of Kharif season in Orissa. Rai 91976) recorded 29 insect pests on this crop from Delhi, but in Orissa termite is one of the

main problems which attacks the crop at different growth stages. A field experiment was laid out on sesamum var. kalika in randomised block design, with replications in the research plots of OUAT with Ten insecticides including water spray as control during Kharif, 1995, and 1996. The treatment included application of two dust formations of HCH 10 D (30 kg /ha) quinalphos 1.5 D (25 kg/ha), six emulsifiable concentrates of endosulfan 35 EC (2 lit/ha), Ec (450 ml/ha), Chlorpyrifes 20 EC, dimethoate 30 EC (750 ml/ha), neem oil, multiplex (16 lit/ha), one granular carbofuran 34 (30 kg/ha) and untreated control. The crop variety was sown during fourth week of June in plot size 5 x 5 m with spacing 30 x 10 cm and fertilizer dose of 30:40:40 kg N:P:K/ha. The plant infestation was recorded by country total number of plants and number of infestated plants from ten randomly selected quadrants (1 m x 1 m size ech0 started from 30 OAS till 75 DAS at fortnightly interval. Then the data were statistically analyzed after square root.

--------, **SHOOTFLY, MAIZE GERMPLASMA, <u>LOCATION OF-</u>.**

158. **RAO (KR) and DANWAR.** Location of sources of Resistance among maize Germplasma against shoot species. <u>Annual Review of Entomology.</u> 4, 1; 1996; 97-9.

This articles deals with the Resistance among maize Germplasma. Twenty one maize varieties were screened against shoot fly species during spring among genotype in respect of

ovipositional preference. However, on the basis of dead-hearts produced, genotypes like AEB (Yellow) composite Autigua Gr. I, African tall, Ageti-76, Ganga-11, EBR composite pop corrn and Decan-103 were observed to be less suspectible. The varieties manely Autigua Gr.I. AEB (yellow0 composite and EBR composite are designate as multiple borer resistance sources as they were reported earlier resistant to the maize stalk borer, chilo partellus sueinhoe.

--------, **SITOPHILUS ORYZAE, RESISTANCE DEVELOPMENT.**

159. **JOIA (BS) and KUMAR (A).** Development of malthion resistance in sitophilus oryzae in Punjab. Journal of Entomological Research. 20, 1; 1996; 53-7.

There has been extensive and intensive use of various insecticides including malathion in storage pramises for the control fo insect pests. The continuous use of the insecticides has resulted in the development of resistance. The LC50 valve of malathion against sitophilus aryzae ranged from 0.238 to 0.4447%, 0.209 to 0.404% and 0.173 to 0.377% for populations from godowns, flour mills and rural houses. This showed resistance ratio ranging from a minimum of 7.0 to G. maximum of 17.9 times. About 60% populations showed maximum tolerance to malathion. The results showed low levels of malathion resistance in all the populatin collectd from different

parts of the state. It is the report which shows the development of resistane in the pest of malathion.

--------, **SOIL PESTS, TERMITES, CONTROL OF-.**

160. **LOGAN (JWM), RAJAGOPAL, WIGHTMAN (JA) and PEARCE.** Control of termites and other soil pests of groundnuts with special refernce to controlled release formulations of non-persistent insecticides. Bulletin of Entomological Research. 82, 1; 1992; 57-66.

Trails for the control of soil pests, particularly termites in groundnuts used chlorpyrifos and isofunphos granules, chlorpyrifos, phorate, carbosulfan in controlled released formulations. Chlorpyrifos controlled release pellets were as effective as oldrin in reducing root and pod attack. Isofenphos and chlorpyrifos granules increased yields and reduced pod samage but to a lesser extent. Other treatment were less effective. Carbosulfan and phorate controlled release formulations and isofenphos granules reduced leaf miner attack. These trials established the efficacy of controlling termites and other soil pests with controlled release formulations of otherwise non persistent insecticides.

--------, **SOGETELLA FURICFERA, WHITE BACKED GLASSHOPPER, ORYZASATIVA, RICE, RESISTANCE, SILICA ROLE OF-.**

161. **HONIKE (K).** Role of silica in Resistance of Rice, Oryza sativa L. to white Backed Glasshopper, sogetslla Furicifea (Horvath). Journal of Kansas Entomological Society. 54, 2, 1992; 190-5.

White Backed Plant hopper, sogetella furcifera (Horvath0 Homoptera: Delphacidae) (WBPH) is one of the five major pest status due to widespread cultivation of Brown planthopper, Nilparvata luqens stat resistant rice varieties Host plant analysis helps in identifying desired trails for incorporation in crop improvement under Modern management Programme Plants Chemicals regulate insect growth and behaviour-Rice vaieties included in the experiments were selected form routing screening against WBPH. Higher silica content of some rice varieties offer resistance to leafhoppers test varieties with resistance ratings in 0 to 9 scale of IRRI.

--------, **SORGHUM, GREENBUG, RESISTANCE, MANAGEMENT.**

162. **ARCHER (T.L), SEGARRA (Eduardo) and BYNUM (ED).** Greenbug Resistance Management on Sorghum with Insecticide Mixtures: Biological and Economic Analysis. Journal of Economic Entomology. 92, 4; 1999; 794-99.

Several tactics were evaluated for insecticide resistant greenbug (Randoni) control on sorghum. Chlorpyrifos provided 60% control but the mixtures of Chlorpyrifost carbofuram +

piperony but oxide provided good control of insecticide resistant greenhug. Application of mixtures of Chlorpyrifos + malathion provided best control followed by chlorpyrifos + carbofuran and chlorpyrifos. When chlorpyrifos was applied to greenbug populations dominated by resistant aphids, yields were lower than in the infested control plots where greenbugs were not sprayed. Economic analysis of the data further demonstrated the advantage of the chlorpysifas + malathion mixture for controlling insecticide resistant greebeg.

--------, **SORGHUM, SHOOTFLY ANTHERIGONA SOCCATA, RESISTANCE INTERACTIVE MECHANISM OF-.**

163. **KRISHNA KUMAR (V).** Interactive mechanism of Resistance to shoot fly Atherigona soccata with seedling characteristics in sorghum. Journal of Insect Behaviour. 62,1; 2000; 68-81.

This article deals with resistance to shoot fly. Among various insect pests that attack sorghum, the sorghum shoot fly, Atherigona soccata Rond has become the principal seedling pest and major threat to sorghum production following intensification of continuous cropping and higher susceptibility of commercial released writers and hybrids. Twenty nine sosghum genotypes belogning to seven different groups were s for their relative resistance to sorghum shootfly. The need to improve an understanding on the relationship to shootlfy resistance in relation to seedling vigour is increasingly being

expressed. A more complete understanding of seedling vigour with different mechanism of resistance is critical to increase the present levels of resistance in high yield background.

--------, **SORGHUM STEM BORER, BACILLUS TURINGINSIS, EFFICACY OF-.**

164. **SHARMA (ML) and ODAK (SC).** Efficacy of Bacillus Thuringinsis separately and in combination with a chemical Insecticide Against Sorghum stem Borer. Annual Review of Entomology. 58, 4; 1996; 354-58.

A number of insecticides have recommended by many workers for the control of sorghum stem borer, chilo partellus suinhoe. Large seale use of chemical pesticides is not advisable as it may prove hazardous besides distribuing the ecological balance. Therfore, to avoid such problems of chemical pesticides Bacillus thuringensis. Berliner was tested against chilo partellus on sorghum. The mixture treatment B thuringiensis endosulfan proved most effective under both foliar and whorl application methods against chilopartellus. The full and half dosages of B. thuringiensis were found to be superior over full and half dosages of endosulfan whorl application of pesticides showed more effectiveness than foliar application. The percent increase in mortality in whorl application was higher in low dosage treatments as compared to higher dosages.

--------, **S. ORYZAE, SITOPHILUS ZEAMAIS, TOXICITY OF-.**

165. **SRINIVASACHARAYLU (BS) and YADAV (TD).** Toxicity of Insecticides Against Sitophilus Zeamais and S. Soyzae. Journal of Insect Behaviour. 59, 2; 1997; 190-92.

Maize wevil, sitophilus Zeamais Motschulsky is reported serious pests of stored maize in 31 countries of the world specially USA, Brazil, China, Mexico. Five Insecticides viz. Deltamethrin, fluvalinate, chlorpyrifosmethyl and malathion were tested against sitophilus zeamais mots and S. oryze lim. Based on the LC50 value deltamethrin was adjudged most toxic to both insects followed by etrimfes and chlorpyrifosmethyl fluvolinate and malathin were found least toxic with interchanging position in the species. At LC95 level, acltanmethrin was most toxic to S. Zeamis but etrimfos emerged most toxic to S. oryzal pushing deltamethrin to next position.

--------, **SOWNMAIZE, ATHERIGONA, RESISTANCE, SCREENING FOR-.**

166. **SHARMA (VK) and SINGH (JM).** Screening for Resistance to Atherigona Spp. in Spring sown maize. Bulletin of Entomology. 37, 1; 1975; 39-3.

Rahter, Chatterji and Asnani (1969) recorded the varying shootfly incidence in 16 different Maize varieties and

categorized them. On the basis of the percentage infested plant. The injury to the Maize Plants as stated by them is also caused in two ways. The major loss is due to the formation of the dead hearst by the feeding of the fly maggots. This results in the complete loss of such plants in the very early stage i.e. three to five leaf stage. The older plants do not show dead heart symptoms but only the distortion of the leaves such plants may or may not recover stunted growth and smaller cob size is the result. Inview of these observations, it was considered desirable to formulate criteria for evaluation of resistance to the shootfly. The present article, therefore, deals with such criteria and sreports the results of screening of 35 maize germplasms for resistance to Atherigona spp. when sown during spring season.

--------, **SPONDOPTERA LITURA, CHEMICALS, VARIABILITY IN RESISTANCE.**

167. **MURUGESAN (K) and DHINGRA (Swaran).** Variability in resistance pattern of various groups of insecticides evaluated against Fabricius during a period spanning over three decades. Journal of Entomidegical Research. 19, 4; 1995; 313-19.

Among the eighteen insecticides tested against the third instar larvae of spondopetra litura (Fab.) deltamethrin was found to be the most toxic insecticide on the basis of LC50. The former fourteen insecticides were found to be more toxic them lindane. Fenthion and dimethoate were less toxic than lindane, being 0.76 and 0.75 times as toxic as lindane. The resistance

built up on S. litura to various insecticides of different groups during the last three decades. An increase in the LC50 value of pyrethrum against S. litura during the period 1961-95 indicated development of resistance to the extent of 20.62 fold S. litura developed 14.71 and 23.05 fold resistance to endosulfan and lindane.

--------, **SPODOPTERA LITURA, CYPERMETHRIN EMULSION, TOXICITY, EMULSIFIERS, EFFECT OF-.**

168. **JAGLAN (RS).** Effect of solvents and Emulsifiers on the Toxicity of Cypermethrin Emulsion to Spodoptera Litera (Fab). Indian journal of Agricultural Sciences. 57, 4; 1995. 309-28.

The full potentialities of insecticides can be exploited by incorporating requisite components in a particular formultion which can optimise its biological efficacy in relation to a particular pest, crop and environment. The biological efficacy of toxicant is influenced to a greater extent by the nature of solvent and emulsifier combination Butler (1974) found increased mortality of Malathion treated black carpet beetle, Attagenus megatona (F) with Regulid Twen 80, Multifilm X-77 and Triton in comparison to five other adjuvants. It is thus necessary to investigate the effect of various solvents and emulsifiers on the toxicity of insecticides to a particular pest under controlled condition with this aim in view, emulsion of cypermethrin were separately formulated with each of six

solvents and seven emulsifiers and their relative efficacy was studied against third instar larvae of S. litura (Fab).

--------, **SPODAPTERA LITURA FABRICIUS, CRYOLITE, EFFICACY OF-.**

169. **RAM PRASAD (S), KRISHNAYYA (PV) and VIJAY LAKSHMI**. Insecticides Efficacy of Cryolite Against Spodoptera litura Fabricius. Journal of Insect Behavior. 58,8; 1999; 43-7.

Median lethal concentrations of cryolite against third and fifth instar larvae of spodoptera litura after 48 and 72 hrs. of feeding on treated castor leaves were 1135 and 1273 ppm and 6008 and 7762 ppm, respectively. Feeding on cryolite resulted in reduction of larvae and pupal weight, percent population and adult emergence. Though cryolite inhibited the larval feeding, it did not repel them cryolite even at 25000 ppm on groundnut crop int eh field did not cause any phytotoxic symptom cryolite is a natural inorganic mineral knows for its stomach action by release of fluoride ions, which form complexes with metal containing enzymes. It is likely that crylite kill the insects by inhibition of several enzymatic processes and not by acting at one specific locus. Further cryolite was recorded sofe to natural enemies and mamals by screemulu.

--------, **SPIDOPTERA LITURA, TOBACCO TOXICITY, EVALUATION.**

170. **ASHRAF (MN).** Evaluation of Toxicity of some insecticides Against the Larvae of Tobacco Caterpillar, Spodoptera Litura Fab. Journal of Agricultural Entomology. 54,4; 1992; 394-8.

Tobacco caterpillar spodoptera litura of chewing Tobacco in North Bihar. It causes considerable damage to the host plant by feeding the leaves (Patel and Chart, 1980 and Show, 1980) Jatwani et al., (1984) cested the susceptibility of insecticides to the different larval instars of the caterpillar. The insecticides so evaluated by them included isodrin, endrin, parathrion, aldrin, endosulfan dieldrin, p', p'-DDT fenitrothion, monocrotophos and carbaryl. The present investigation reports the results of evaluation of toxicity of some 10 commonly available insecticides against the neonate larvae of S. litura.

--------, **SPRAY, MUSTARD APHID, SRPAYING EVALUATION OF-.**

171. **SINHA (RP).** Evaluation of Different spray Schedules for control of Mustard Aphid. Bulleting of Entomology. 59,2; 1997; 179-86.

Rape and Mustard (Brassica spp.) are the primary and important oil seed crops and constitute the Major source of edible oil for human consumption in the country fieldtrial was conducted to find out the most effective and econmical insecticide spray schedules to control mustard Aphid. Phosphamidon proved most effective against the aphid in one as

well as two spray schedule it remained effective for 15 days in one spray. Schedule and it provided protection against the aphid for 30 days in two spray schedule with repeat application after 10 days. Two spraying of phosphamidon proved superiod to one spray both in its efficacy against the pest and larger net gain. The insecticides used showed a decending order of efficacyas phosphamidon > dimethate > lindane > thiometon > carbary > Malathion > chlorpyriphos > endosulfan > quinal phos.

--------, STEMBORER CHILOPARTILUS, SORGHUM, RESISTANCE EVALUATION OF-.

172. **PREM KISHORE.** Evaluation of twin resistance sources amongst advance generation derivatives in Sorghum to shootfly, Atherigona soccata Rondani and Stem borer, Chilo partillus. Journal of Entomological Research. 16,3; 1992; 236-41.

Twin sources of resistance to the shootfly, Atherigona soccata Rona and steam borer, chilo partillus were selected from a large number of advanced generation derivatives obtained from crosses between tropical and exotic dware temperature sorghums at the I.A.R.I. Eleven such germplasms were subjected to screening against both the shootfly and stem borer to select best sources of resistance to these two pests. Five entries like E103, E108, E109, E112, E358 showed multiple resistance to both the shootfly and stem borer during the two years of field experimentation. All these twin sources of

resistance are dual purpose sorghum (grain and fodder) with desirable agronomic attributs.

--------, STORED PRODUCTS, INSECTS PESTS, EVALUATIONS.

173. **SRIVASTAVA (AV), NARAIN (K) and BHANDARI (PD).** Evaluation and Assesment of newly reported Insecticides for the control of Insects pests of stored products. Bulletin of Entomology. 13,1; 1991; 219-25.

Six Insecticides (fenthion fenitrothion, safrotin propetamphos), Ripcord [cypermethrin], Satis for [etrimfos] and Malithrin [Phenothrin], were compared with Malathion in residual films or by topical application against, Insect pests of stored products. Fenthion was most effective against Tribolion castaneem, sitophilus myzae, Rhyzopertha dominica, Trogoderma granarium and Teriplant Americana. Fenitrothion was effective against R. dominica and P. americana. Fenitrothiowas effective against s5 oryzae. This paper was presented at a symposium on Entomology or Defence purposes held in Gwaliar, India, on 12-14 September, 1990.

--------, SUGAR BEET SEED, CHEMICALS.

174. **WINDER (G) and DEWAR (A).** New insecticide for sugar beet seed. British Sugar Beet Review. 56,2; 1998; 23-6.

The article deals with the development of insecticidal treatments against soil pests of sugarbeet. The composition of

seed pellets was changed from clay to wood-flour. Trials in the past 5 years have shown that methiocarb applied to this new pellet had little or no effect. Trials included methiocarb, carbosulfan, furathiocarb and tefluthrin. Tefluthrin was by far the best candidate and plant establishment was as good when 5 g a.i. was applied to a unit of 100,000 seeds as for 30 g/unit. Furathiocarb at 60 g a.i./unit was the next bets treatment, although it gave only marginal improvement over the lower rates of furathiocarb and all rates of carbosulfan.

--------, **SUGAR BEED, RESISTANCE DEVELOPMENT OF-.**

175. **MEDVECKY AND ZALOM (FG).** Development of Resistance in sugar beed seed and the application of new insecticides. Journal of the Kansas Entomological Society. 96,4; 1996; 44-5.

The development of insecticidal treatments against soil pests of sugarbeet in the UK in the past 20 years. In 1995, the composition of seed pellets was changed from clay to wood-flour. Trials in the past 5 years have shown that methiocarb applied to this new pellet had little or no effect. Trials in 1996 included methiocarb, carbosulfan, furathiocarb and telfuthrin. Tefluthrin was far the best candidate and plant establishment was good when 5 g was applied to a unit of 100,000 60 g a.i./unit was the next best treatment, although it gve only

marginal improvement over the lower rates of furathiocarb and all rates of carbosulfan.

--------, SWEET POTATO WEEVIL, POTATO, RESIDUAL TOXICITY, STUDIES ON-.

176. **SINHA (AK).** Studies on comparative residual Toxicity of Insecticides to sweet potato weevil. Journal of Applied Entomology. 56, 2; 1994; 123-8.

Sweet Potato (Ipomea batatas L.) is grown extensively throughout the tropics and subtropics and sweet potato weevil, cylas formicarius Fabricous, (Coleoptera, curulionidae) is a universally occurring pest and causes extensive damage. The female lays eggs in small pockets at base of the stem and in the tubers and vines aretunnell by small white and legtes larvae. The tunnels may be partially filed with grass the ability of the adult to fly is very limited. The Pest is mainly dispersed through planting material i.e., tubers and stem cutting. Treatment of stem cuttings with insecticides before planting reduced pest infestation in field (Rhodes 1959; Ingarn, 1967). Treatment of planting material before planting and spraying of in field with insecticide, are commonly recommended for conrol of the pest (Sharman 1951, Pillai et al., 1981). Inview of this, comparative residual toxicity of 40 insecticide to the pest on foliage and effect of selected four insecticides on planting material were determined and results are reported herein.

--------, **SYMPATRIC POECILUS, HERBICIDES, EFFECT OF-.**

177. **KEGEL (B).** Effects of selected herbicides and insecticides on the larvae of three sympatric poreilus species (col., carabidae). European Journal of Entomology. 108, 2; 1989; 144-55.

The side effects of the insecticides Ekmet Hostquick and Dursban and the herbicides Tribunil (meta benzthiazuron), M52 (MCPA), Fusilad (fluazifop-butyl) Gesaprim 500, Gesatop 500 (simazine) and Recendup (glyphosate) on the larvae of 3 species of Poecilus were investigated in the laboratory using proging of adults collected in cereal fields in west Berlin. All larvae coming in contact with the insecticides showed symptoms of severe poisoning after 2 days. Mortality due to the herbicides tested was less than 50% in all cases. The duration of development upto adult emergence was significantly longer than normal when 2nd instart larvae of P. versicolor were exposed to etrimpos or heptenophos; the herbicides had no effect on development time.

--------, **SYNTHETIC PYRETHROIDS, MYZUS PERSICAL, RELATIVE TOXICITY.**

178. **DHINGRA (S).** Relative Toxicity of some important insecticides with particular reference to change in susceptibility level of Myzus persicae sulz. to synthetic Pyrethroids. Bulletin of Entomology. 17, 2; 1993; 99-101.

The relative Toxicity of emulsions of 9 propericatory formulations of insecticides was evaluated in the laboratory against myzus persicae using aphids derived from the field in New Delhi, India. On the basis LC50s, fluvalinate, Lamb da-cyhalothrin, delta methrin, genvalerate, alphametrum Talpha cypermethrin demeton methyl, cypermethrin and phosphamidon were 209.3, 63.7, 40.8, 26.3, 9.0, 5.0, 3.0 and 1.4 times as toxic respectively as fenpropathrin. Cypermethrin and fenpropathrin may not provide effective control of the aphid and the development of resistance to cypermethrin has been rapid.

--------, **TETRANYCHUS, SUNFLOWER, RESISTANCE, SAFFLOWER.**

179. **NAVVAB - GOJRATI (HA) and ZARE (N).** Resistance of different varieties of sun-flower and safflower to Tetrancyhus turkestani vgarov and Nikolski in Southern Iran. Indian Journal of Agricultural Sciences. 44,1; 1992; 299-03.

This articles deal with a great deal of work that has been done regarding analysis of various sunflowerr and safflower varieties having resistance to diseases and pests. Mites are known to occur on safflower in many regions of the world, with varying degree of infestation and damage. The carmine spider mite, T.l Telarius (L) has also been recorded on safflower in many countries of the middle East and Africa. However, reportedly it does not damage sofflower. Recently, T. Turkestani Vagarov and Nikolski the strawberry spider mite has

been found to infest both safflower and sunflower in Southern Iran.

--------, **TEXAS, KANSAS, GREENBUGS, RESISTANCE, OCCURRENCE OF-.**

180. **SHUFRAN (Ronanne. A), WILDE (Gerald E), SOLDERBECK (Phillip) and MORRISON (william).** Occurrence of Inecticides Resistance Greenbugs in Kansas, Texas, Oklahoma and Colorado and suggestions for Management. Journal of economic Entomology. 90, 5;1997; 1106-15.

Insecticide resistance in Greenbugs, was first reported in the mid 1970s when control failure with disulfoton were noted in Tekas, kansas, Oklahoma etc. But after applying Polyacrylamide gel clectrophoresis was used to residue esterase insozymes that were related to insecticide resistance in Greenbug. The occurrence of resistant greebugs appeared to be greatest in the southwest crop reporting district of Kansas and the North Plains. The overal incidence of pattern 1 resistant greebugs declined from 7.1% in 1991 to < 1% in 1994. Several explanations for the spatial occurrence of resistant greenbugs and several techniques for managing resistant greembug populations are offered.

--------, **TOBACCO BUDWORM, BIODEGRADABLE, RESISTANCE DEVELOPMENT OF-.**

181. **KANGA (LH) and PLPPA (FW).** Development of a technique to monitor resistance to biodegradable insecticides in field populations of tobacco budwarm. Environmental Entomology. 88, 3; 1995; 87-90.

A procedure involving the use of glass vials containing insecticides was developed to monitor for resistance to biodegradable insecticides among field populations of adults of Heliothis virescens. These insecticides are replacing pyrethroids for the control of H. Virescens in areas where pyrethroid resistance is a problem. The loss of toxicity was caused mainly by hydrolytic degradation of the insecticides rather than volatilization. The addition of an organic acid to the vials significantly extended the stability of insecticide residues. Combinations of insecticides plus benzoic acid and storing them in a freezer is the preferred usefulness of this technique was confirmed by GC analysis of insecticide residues and by field monitoring data.

--------, **TRIBOLIUM CASTANEUM, RED FLOUR BEETLE, RESISTANCE, MALATHIONS, EVALUATION OF-.**

182. **SAXENA (JD) and SINHA (SR).** Evaluation of some insecticides against malathion - Resistant strain of Rust Red Flour Bettle, Tribolium castaneum. Bulletin of Entomological Research. 57,4; 1995; 401-05.

Malathion has been extensively used for the control of stored grain insect pests all over the world since its introduction in late 50's. It's continuos use has resulted in the development of resistance in most of the species of the stored grain pests, including rest red flour beetle Tribolium castaneum, champ and Dyte in India during a recent survey high level of malathion resistance has been found to prevail in. T. castaneum throughout the country. It was through desirable to assess the efficacy of some insecticides for the control of matathion resistance strain of T. castaneum. Sincke pyrethories have been found to be very effective against many field and storage pests, Ramzan and Chahal 1987 and are likely to be introduced in controlling stored grain pests, therefore, some of them have been included in the study.

--------, **TRIBDIUM CASTANEUM, RESISTANCE, DELTAMETHRIN, MEASUREMENT, BIOASSAY-TECHNIQUES, EVALUATION OF-.**

183. **SINHA (SR) and SAXENA (JD).** Evaluation of different Biossay Technique for the mesurement of Deltamethrin Resistance in Tribolium Castaneum. Indian Journal of Agriculture Sciences. 62,4; 2000; 341-45.

The suitability of five bioassay methods viz, stopical application, film, rearing medium, filter paper unpregnation and direct spray was evaluated for measuring delta methrin resistance level is a laboratory selected strain of tribolium

castaneum. Among all the methods tested, the highest resistance ratio was found in topical application method followed by film, filter paper impregnation, rearing medium direct spray method results also showed that higher resistance ratio depicting the sensitivity of the methods depends upoon the lower LC50. Thus the topical application method was found to be most suitable followed by film and rearing medium methods to measure the resistance in a population having even a low level of resistance.

--------, **TRIBOLIAM CASTANEUM, RESISTANCE, DELTAMETHRIN.**

184. **SAXENA (JD) and SINHA (SR).** Decline of Resistance in a laboratory selected Deltamethrin Resistance Strain of Tribolium castansum, After cessation of Insecticidal selection Pressure. Bulletin of Entomology. 58, 4; 1996; 280-83.

The decline of resistance level after cassation of an insecticidal pressure has been demonstrated in several insect species by many workers. The decline of resistance in a laboratory selected deltamethrinresis resistant strain of Triboluim castaneum, after suspension of insecticidal pressure was studied. The resistant strain was earlier developed in the laboratory after 6 generations of selection. The resistant strain was reverted back to susceptible level after 18 generation of suspension of selection pressure but reduced the nearly half in second generation. The deltamethrin resistance was developed

to a very high level in just over a year. While the reversal of resistance to the susceptible level took about 3 years.

--------, **TRIBOLIUM CASTANCUM, MALATHION RESISTANT, CROSS-RESISTANCE.**

185. **CHAWLA (RP) and KAN (BK).** Cross resistance spectrum of malathion Resistant strains of Tribolium castancum. Indian Journal of Agricultural Sciences. 62,2; 1999; 127-32.

The comparative susceptibility pattern by FAO recommended method malathion susceptible strains from Faridkot and Malathion specific resistant strains from Bhatinda, Ludhiana, Roper, Jalandhar and Amritsar having resistance ratio of X7.75, X8.25, X17.25, X11.25, X6.75, respectively showed no significant differences in susceptibility status between the two types of strain with several organo-phosphorus insecticides, viz. Bromophos, idofenphos, dichlovos, primiphos methyl, fenitrothion and synthetic pyrethroids viz. Cypermethrin, delta-methrin, as-permethrin, transpermethrin and fenvalerate. Present results also showed that phosphine resistant strain (X10), belonging to Jagraon was fully susceptible to malalthion and thus phosphine resistant did not extend to malathion amaong the insecticides tested, deltamethrin, dichloves fenvalerate and primiphos methyl have been worked out for utilizing in assessing the emerging problem of resistance to such newly introduced insecticides.

--------, **TRIBOLIUM CASTANCUM, PHOSPHIRE, INHERTANCE.**

186. **BENGSTON (Mervyn).** Inheritance of phospline Resistance in Tribolium Castaneum (Colleoptera; Tenebrionidae). Journal of Economic Entomology; 92,1; 1999; 17-20.

The red flour beetle Tribolium castaneum (Herbst) is an ubiquitous pest of stored cereals, legumes and many other commodities in tropical and subtropical climates. The genetics of phosphine resistance was studied in a resistant strain of the red flour beelte (Herbst), developed from field collections in queenstand, Australia. A program of inbreeding and selection was maintained for 5 generation to promote homozygosity in this strain and laboratory susceptible strain. The strain was then 12.7 times resistant in the and Agriculture organization of the United Nations test on adult insects. Data from the testing of f_1 progeny from the reciprocal corsses (R 0 x S 0 and S 0 x R 0) indicated that resistance was autosomal and semidominant with a degree of dominance. Modified chi-square analysis and resistant strain analysis of data from the response of test crosses of f_1 progeny to both tehe susceptible and on f_2 progeny were highly significant. Low-level resistance typical of Australian population of T. castaneum is conferred by 1 gave.

--------, **TRIBLIUM CASTANEUM, PLANT, DELTAMETHORIN, EFFICACY OF-.**

187. **DOLLY KUMAR and SUNITA PARIKH.** Efficacy of Deltamethrin on Inactive Developmental al stage of Tribolium castaneum. Environmental Entomology. 58,3; 1996; 260-63.

Ues of conventional Insecticides organophospherus and organochlorines) has caused emergence of resistant strains in several stored product inssect pests, since Tribolium castaneum Herbst is one of the most serious pests of stored grain products, tremendous efforts have been made through research to control it. Even the synthetic pyrethroids have been tried agents to adult stage but very little information is available on the effect of deltamethrin on the inactives stage of T. castaneum. The The bioefficacy of deltamethrin (a synthetic pyrethroid) on the inactive developmental stages (egg and pupal) of T. castaneum was evaluated. Hatching rate fall consider only when kept in contact with different concentration of deltamethrin on topical application to pupae, a significant fall in adult emergence was recorded at different concentrations. Abnormal adults emerged at lower doses whereas at higher dose adult emergence did not lake place.

--------, **TRIBLIUM CASTANEUM, RESISTANCE, LINDANE, STATUS OF-. INDIA.**

188. **SINHA (SR) and SAXENA (JD).** Status of Lindane Resistance in Tribolium Castaneum in India. Journal of Agricultural Entomology. 59, 1; 1997; 62-8.

Lindane resistance in Tribolium castaneum was found to be prevalent in thirty-five out of the forty five strain tested. The resistance ratio ranged from 1.2 to 16.1. Although lindane was not in use in government geolowrs for the last three decades in controlling the stored grain pests, however, resistance to it has found in most parts of country. Lindane had been most common insecticide used in controlling the stored grain pests, since it replaced DDT which had limited use after past war years. Lindane resistance has been found to be present in almost all the countries of the world in different species of insects. It was most prevalent in T. castaneum as 75 out of the 76 countries sampled showed resistance to lindane. These studies were thus, aimed to find the spresent level of lindane resistance in T. castaneum in the country.

--------, TRICHOGRAMMA CHILONIS, EGG PARASITOID, EFFECT OF-.

189. **MALATHI (S), SRIRAMULU (M) and BAHU (TR).** Effect of certain ecofriendly insecticides on the Egg parasitoid Trichogramma chilonis (Ishii) Hymenoptera: Tricho grammatiodae). Journal of Entomological Society of British Colombia. 27; 1999; 1-2.

Seven eco-friendly insecticides, Piple Delfin Biobit Biolep, Bioasp (Bacellus thuringiensis formulations), were evaluated for their effects on Trichogramma Chilonis (Ishii), an important egg. Parasitoid. Biobet and Green commands did not affect the

parasitisation and development of T. chilonis on corcyra cephalonica when exposed before and after parasitation. In general these ecofriendly insecticides exhibited little effect on parasitisation of T. chilonis when exposed after parasitisation as compared to when spray and exposed. Endosulfan was really very toxic.

--------, TRITICUMAESTRIUM, WHEAT, OBESI-HOLMGREN, MECRATERMES, ODONOTERMS, TERMITES, EVALUATION OF-.

190. **KUMAWAT (KC).** Evaluation of some Insecticides Against field Termites, Odonoterms obscus Rambus and Microtermes obsi Holmgren in wheat, Triticumaestivum. Indian Journal of Plant Protection. 9,1; 2001; 51-3.

Termite damage in wheat crop usually occurs at germination and more serious at emergence of the earheads. The attacking termites cat the roots resulting in yellowing of leaves and finally health of the lant in case of severe infestation. At the earhead, the damage is by chaffy earheads with little or no grain formation. The earlier recommendations to control termites in wheat crop included seed treatment of wheat before sowing with aldrin emulsion (at 400 ml of aldrin 30 Ecq seed) which remained effective for the crop season and enhanced the wheatyield. Alternatively soil mixing with 10/BHG dust or 5% heptachlor @ 20-25 kg ha^{-1} was recommended. These chlorinated hydrocarbon insecticides leave harmful residues on

food stuff and are highly hazardous to the human death and nion target organism. This was to find out the alternatives and to recommend the effective and economic for seed and soil treatment against termites.

--------, TROGUDERMA GRANARIUM, PHOSPHINE STRAIN, CROSS-RESISTANCE OF-.

191. **SHARMA (DR) and KALRA (RL).** Cross-Resistance of Phosphine strain of Trogoderma granarium Everts to Insecticides. Annals of Plant Protection Sciences 6, 2; 1998; 198-200.

The Khapra beetle, Trogoderma granarium Everts has been found to be an exteremely difficult pest to control because of natural tolerance of its larvae to insecticides and phosphine. Besides the natural tolerance, T. granarium has also been reported to develop resistance to phosphine. Thus, such a condition would pose a serious threat in the successful use of phosphine and alternative insecticides with different modes of action are required to prolong the effective life of this useful jumigant. Third Instar larvae of the resistant strain (KTG) initially collected from a farmer's house in Punjab. Cultures of BTG and KTG strains of T. granarium were reared in glass Jars. The relative tolerance of fifth-instar larvae of KTG and BTG strains to organophosphorus (quinal phos, malathion and fenitrothion) and synthetic pyrethroid 9deltamethrin, cypermethrin and tenvalerate) insecticides, of more than 95%.

On ml of actone solution of 5-6 graded concentrations of each insecticide was applied. End point mortality was observed at 5 day intervals. The LD50 values of inscticides for fith instar larvae of BTG and KTG strains of T. granarium revealed. Cross resistance of KTG strain is available.

--------, UNSPRAYED, KEY PESTS, EFFECT OF-AGRONOMIC PRACTICES.

192. **BUTTER (NS).** Effect of Agronomic Practices on the Incidence of Key Pests of cotton under unsprayed conditions. Journal of Entomological Society of British Columbia. 54, 2; 1992; 115-23.

Cotton is an important Kharif crop of India, Punjab state and is grown on an area of about 7.5 lakh hectare with a total production of about 21 lakh bales. It suffers a great loss due to the attack of various insect pests, out of which Jassids and bellworms are most serious ones. Butter et al, 1987. These pests can be controlled by the use of various insecticides Anonymous, 1987). However, the indiscriminte use of these chemicals can result in several ill-effects viz, health hazards, environmental pollution, development of resistance in insect and appearance of secondary pests. Under these circumstances it becomes very necessary to find out some alternative methods of their conrol out of which the manipulation of the cultural practices can be great help in formulating the integrated pest management system. The present study was therefore, undertaken to

evaouate the effect of sowing time intra-row spacing nitrogen levels and varieties on the incidence of cotton jassid and bollworms under unsprayed condition.

--------, **USE OF BARK BEETLE, PROSPECTS.**

193. **WULF (A), PEHL (L) and BERENDES (KH).** Prospects for using systemic insecticides against bark beetle. Annals of Entomological Society of America. 48,8; 1993; 211-14.

The Preparation Toimaron (methamidophos) was applied into stem of two Narway spruce (Piceaabies) trees about 45yr old as a 1:/mix with water in two ways : (A) injected into the outer spwood by means of a swiss. Bir chmeris injector using CO_2 pressure to give 8 injections each of 40 ml Tamagron; and (b) poured into 8 holes drilled 20 mm diameter and 10 cm deep into the sapwood and then pluged with silicon. Four weeks later, wood samples were taken from the trees, and exposed to attack by the bark beetle Pityogenes chalcographus in the laboratory. The results indicate that the development of bark beetles can be largely prevented by the use of systemic insecticides injected into the sap stream.

--------, **VIGNA UNGEGEICULATA, COWPEA, FUNDELLA CISTIPENNIS, POD BORER, JAMINICA.**

194. **WILLIAMSON (TM).** Field Evaluation of Insecticides for the control of Pod Borer Fundella cistipennis and other insect pests

of cowpea, vigna unguiculata in Jamaica. Entomological News. 68, 8; 1993; 59-01.

The field trials carried out in cowpeas viz. African Red in 1980 in Jamaica out of 8 insecticides treatments Decis deltamethrin at 2.6 and 5.1 ml/litre was the most effective threatment against insect pests, especially fundella cistipennis [F. pellucens]. It was effective but the resistance developed when field evaluation was again carried out.

--------, **VIRUS, SPODOPTERA LITURA, RESISTANCE DEVELOPMENT.**

195. **MONOBRULLAH (MD) and MASAO (KR).** Developmental resistance in orally inoculated mature larvae of spodoptera litura Fabricius to its nuclear polyhedrosis virus (NPV). Journal of Entomological Research. 25,1; 2000; 1-8.

The articles deals with the developmental resistance in larvae of spodoptera litura. An increase in LD50 and LT50 values with increased larvae larvae age was recorded in bioassy studies of a nuclear polyphdrosis virus infected spodoptra litura Fabr. The estimating LT50 increased with the increased larvae age, whereaas in decreased with the increased doses. Larvae > 11 day old were not infected through oral inoculation. However, intrahaemocoelic injection of NPV into nature larvae resulted into death due to viral infection, indicating a leak of

susceptibility possibly due to get mediated barrier that developed as the larvae approached pupation.

--------, **WHEAT, CHEMICALS FERTILIZERS, CHANGES.**

196. **CHIKHACHEVA (Yun), EROFEEVA (LA), FILIPPOVA (VA) and MITYUSHINA (GA).** Changes in the numbers of individual representatives of the wheat field biocoenosis in relation to the time of application of insecticides. Entomological News. 9; 1991; 96-03.

The results are given of studies conducted in different areas in the southern (former USSR in and 6 organophosphorus compounds) applied at sprouting stem slongation and heding on populations of aphids, thirps entomophages and soil inhibiting invertebrates in fields of winter wheat as well as on the monosacharide and nonprotein nitrogen contents of the plants. Plant pest and phytophage-entomophage trophic connectiosn were also strongest at this time when both the direct effects of chemicals on the insects and also trophic changes in the plants are most manifest. Changes in the food base of the natural enemies appears to be one of the chief factors involved in the after effects of insecticide applications. Early insecticide application should be approached with caution.

--------, **WHEAT, HESSIANFLY, CONTROL OF-.**

197. **BUTIN (GD) and HUDSON (RD).** Spring control of the Hessian fly (Diptera; Ceciolomyiidae) in winter wheat using Insecticides. Journal of Entomological Society of British Columbia. 84,6; 1991; 1913-19.

A series of field studies was carried out in Georgia, USA, to assess the feasibility of controlling spring infestations by mayetiola destructor in winter wheat using foliar insecticides (disulfaton and carbofuran at 0.56 and 1.12 kg a.i/ha; granular disulfaton was also applied at 1.2 and 2.24 kg ai.i./ha). Single applications of disulfaton were not effective in reducing numbers of the pest or preventing yield losses when applied after plant spike emergence. Repeated applications (4-6 sprays) reduced spring infestations and prevented losses of grain yield of spraying began during stem elongation and before peak egg deposition. However, because of inconsistent efficacy marginal economic benefits, and difficulty of predicting overpoisition activity management of spring infestations using foliar insecticides is not considered to be currently feasible.

--------, WHEAT, PARAKEETS, RESISTANCE.

198. **VIJAY SINGH and SHARMA (RP).** Resistance of Parakects in wheat. Journal of Agricultural Entomology. 58,1; 1996; 74-8.

Evaluation of eight wheat lines was done for parakect resistance through field experiments conducted for three years revealing statistically significant varietal differences three lines

HPW49 WH 534 and WH551, were found to be most resistant two HS284 and HDR 77) were intermediate and the remainign three 9Kalyan Sona, WP72 and C306) were highly susceptible. Critical observations on various peduncle and spike characteristics revealed that parkeet resistance was conferred by shorter emergence length of peduncle. Wheat crop during earhead stage is highly vulnerable to about 22 species of bird depredants and losses up to 27 percent have been reported due to these. During plucking transit and while feeding many earheads fall down, which are not picked by these birds who go back to the field to collect from earheads. They seem to have no redeeming virtues whatsoever from the cultivators or any other economic point of view and their number deserve to be kept under strictest check.

--------, **WILLAMETTE, FIEBERT APHID, VARIABLE RESISTANCE.**

199. **KATUNDU (JM) and ALINIAZEE (MT).** Variable resistance of filbert aphid to insecticides in the willamette valley. British sugar Beet Review. 83,1;1990; 41-7.

Development of resistance in Myzocalis coryli to commonly used insecticides was investigated using the leaf-dip technique on infested filbert leaves. Resistance levels varied from 1.5 to 4090 fold for carbaryl 1.2 to 288 fold for diazinon. 1.8 to 80 fold for endosulfan and 3.4 to 112.4 fold for oxydementonmethyl. Some seasonal variations were noticed

with some exceptions, summer and autumn population were generally more resistant to pesticides than the spring populations. Although development of resistance on a regional basis was not evident of more localized resistance was observed.

--------, XENOBIOTICS, INSECTS, DEVELOPMENTS.

200. **HODGSON (E) and KHUR (RJ).** Safer Insecticides: devlopment and use. Annals of Entomotogical Society of America. 7; 1990; 593.

General approaches by which now safer compounds may be developed and by which insecticides already in use may be manufactured and, used more safely are considered in this books 15 chapters. The contents include: metabolism of Xenobiotics quantitative structure activity relationship of insecticides: serious system based insecticides, endocrine based insecticides. Insecticides based on difference in melabolic pathways, inducers of plant resistance to insects; proinsecticides: metabolically activated toxicants; natural products from plans for the control of insect pests; viruses and bacteria as sources of insecticides; spides toxins as lead structures for novel pesticides; an integrated approach for improvements in application technology; improved safety through reduction to the manufacture of agrochemical in the USA and the Third world; and challenges the industrial view point.

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JOURNAL CONSULTED

Name of Periodicals	Place of Pub	Periodicity
Annals of Applied Biology	New York	Monthly
Annals of Entomological Society of America	America	Bi-monthly
Annual Review of Entomology	USA	Bi-Monthly
British Sagar But Review	America	Quarterly
Bulletin of Entomological Research	USA	Bi-monthly
Bulletin of the Entomological Society of America	America	Monthly
Bulleting of Entomology	India	Monthly
Entomological News	America	Monthly
European Journal of Entomology	Europe	Quarterly
Indian Journal of Agriculture Sciences Environmental Entomology	New Delhi	Quarterly
Indian Journal of Applied Entomology	India	Monthly
Indian Journal of Entomology	India	Monthly
Indian Journal of Plant Protection	India	Monthly
Journal of Applied Entomology	Berlin	Quarterly
Journal of Economic Entomology	America	Monthly
Journal of Entomological Research	India	Monthly
Journal of Entomological Society of British Colombia	Colombia	Bi-monthly
Journal of Environment Sciences and Health	USA	Monthly
Journal of Insect Behavior	India	Monthly

Journal of Research ANGRAU	America	Monthly
Journal of the Kansas Entomological Society	Kansas	Quarterly
Madras - Agricultural Journal	India	Monthly
Natural Economis of Insect	USA	Monthly
The Canadian Entomologist	Canada	Bi-monthly